THURSDAY, JUNE 11, 1891.

MAMMALS LIVING AND EXTINCT.

An Introduction to the Study of Mammals Living and Extinct. By W. H. Flower and Richard Lydekker. (London: Adam and Charles Black, 1891.)

THIS work is, as the authors inform us in the preface, based largely upon the article Mammalia, together with forty shorter articles, written by Prof. Flower for the ninth edition of the "Encyclopædia Britannica." Certain other articles by Dr. Dobson and Dr. St. George Mivart have also been made use of. The illustrations, most of which are admirable, are chiefly those prepared for the "Encyclopædia," but many have been added. Mr. Oldfield Thomas, of the British Museum, has assisted the authors in special matters. To Mr. Lydekker fell the task of arranging the various articles made use of in proper sequence, filling up gaps and adding new matter, a large amount of which treats of the extinct forms.

The book resulting from this process is undoubtedly one which will be found interesting and useful by all students of zoology. There is a great deal in it which is worth reading; especially so are the four introductory chapters on general anatomical characters, origin and classification of the Mammalia, and on geographical and geological distribution. Moreover, with regard to important animals such as the horse, sheep, goat, pig, a great deal of accurate information of varied character is given. The whales are, as we should expect, treated with special mastery, and throughout the book we come upon pages which are models of lucid statement and judicious selection of matter.

It should, however, be clearly understood that the book is not and does not profess to be a complete work of reference on the Mammalia. The references to extinct groups are exceedingly scanty, and whilst they serve to stimulate the reader's desire for further information, do not, as a rule, furnish him with the titles of original works in which such information is to be found. The bulk of the work consists of chapters treating of the orders of Mammalia in systematic sequence, and there is no doubt that, both for the general reader and for the more technical zoologist, they form a mine of valuable information well up to date, and as a rule well set forth by the aid of illustrations. As an example of the latter, I may refer to the excellent woodcuts of the skull of Tritylodon from the Trias of South Africa, and of various lower jaws illustrating the section on Mesozoic Mammalia; but additional figures of this most important and little known series of forms would have been welcome, and one reads with unfeigned disappointment the declaration that "it would be beyond the scope of the present work to describe in detail, or even to mention the names of, all the members of this group."

There are one or two points of general interest in the earlier chapters to which I may briefly call attention.

The view originally formulated by Huxley, that in looking among Vertebrates for the progenitors of the Mammalia we must pass over all known forms of birds and reptiles and go right down to the Amphibia, is maintained by the authors, whilst reconciling this conclusion with Prof. Cope's important observations on the remarkable resemblances which obtain between the extinct reptiles known as Theromorpha (Theriodontia, Pelycosauria) and the Monotreme Mammals. Recent observations have shown such an intimate connection between the South African Theromorpha and the Labyrinthodont Amphibians that there can, our authors maintain, be no hesitation in regarding the one group as the direct descendant of the other, and "we may probably regard the Mammalia as having originated from the same ancestral stock at the time the Amphibian type was passing into the Reptilian."

In reference to classification, the authors observe that it is a simple matter to indicate natural groups, such as orders and sub-orders, among existing Mammals, but when we pass to the extinct world all is changed. New forms are discovered which cannot be placed within any of the existing divisions. "Our present divisions and terminology are," say Prof. Flower and Mr. Lydekker, "no longer sufficient for the purpose [of a classification which shall embrace extinct forms]; and some other method will have to be invented to show the complex relationships existing between different animal forms when viewed as a whole." Apparently the authors mean, by the last five words of this sentence, "when all are viewed together." The necessity for drawing up lists and catalogues in a linear series is deplored, but unhappily no attempt is made by the authors to grapple with the difficulty. A classification of the Mammalia in a linear series is given as far as families; and the names of groups containing only extinct forms are printed in special black type. I should have been very glad to see some attempt to set forth in the form of genealogical trees the senior author's views on the genetic relationships of this confessedly artificial linear series. I cannot admit that the division of the Mammalia into three groups—Prototheria, Metatheria, and Eutheria, or, as De Blainville called them, Ornithodelphia, Didelphia, and Monodelphia—expresses a natural fact, if these three groups are regarded as equipollent, and as succeeding one another as three "grades" of evolution. It is not difficult to come nearer to an expression of actual genealogical relations than this. It appears preferable to divide the Mammalia primarily into two grades: (A.) the Monotrema, and (B.) the Ditrema; only so do we give expression to the wide gap by which the archaic characteristics of the Monotremes separate them from all other Mammals. Then we can divide the Ditrema—not into two successive *grades* of structure—but into two diverging *branches*, viz. Branch *a.* Marsupialia, and Branch *b.* Placentalia. Of the Placentalia our authors say that their affinities with one another are so complex that it is impossible to arrange them serially with any regard to natural affinities. They might, however, it seems to me, embody their own conclusions in classificatory form, and divide the Placentalia into four diverging sub-branches, the chief being (*a*) the Typidentata, the three others being (*b*) the Edentata, (*c*) the Cetacea, and (*d*) the Sirenia. The group which I call Typidentata our authors actually define, though they do not name it and use it as would surely be convenient. They say, "The remaining Eutherian Mammals [*i.e.* Placentals after exclusion of Edentata, Cetacea, and Sirenia] are clearly united

by the characters of their teeth, being all heterodont and diphyodont with their dental system reducible to a common formula." I have for many years made use in my lectures of the classification of Mammalia above indicated which may be summarized thus :—

Class MAMMALIA.

Grade A. MONOTREMA.
Grade B. DITREMA.

Branch *a*. Marsupialia.		Branch *b*. Placentalia.	
Sub-br. *b*. Diprotodontia.	Sub-br. *a*. Polyprotodontia.	Sub-br. *d*. Cetacea.	Sub-br. *a*. Typidentata.
		Sub-br. *b*. Edentata.	Sub-br Sirenia.

No doubt it is difficult, even with the use of the additional terms "grade," "branch," and "sub-branch," to set forth the relations to one another of the known orders and sub-orders of Typidentata; but the attempt must be made, and there are materials in the present work for gathering some indications of the form which such a tentative pedigree would take had the authors gone so far as to formulate it.

In the chapter on geographical distribution, the six zoological regions of the globe proposed by Dr. Sclater in 1857 are accepted. But here, as in regard to the treatment of morphological groups, it seems that a primary grouping of the divisions recognized might with advantage be introduced, which would give a truer expression of the historic relations of existing land surfaces than that adopted. Reference is made to the proposed elevation of New Zealand into a primary region, but would not the truth be more nearly expressed by separating New Zealand and the rest of the world first of all, as Atheriogæa and Theriogæa? Should not the Australian region next be separated from the rest of Theriogæa? Theriogæa would then be divided into the Terra Marsupialium and the Terra Placentalium (without prejudice to the recognition of the occurrence of a limited number of Marsupials in the latter). The Terra Placentalium includes the five regions called by Sclater Palæarctic, Nearctic, Neotropical, Ethiopian, and Indian. The authors of the present work mention Dr. Heilprin's opinion that the Palæarctic and Nearctic regions should be united and called the Holarctic region. But they do not adopt this opinion, nor refer to Huxley's proposal to term this same area Arctogæa, and his suggestive speculations as to the successive connections of the three great peninsulas (as they are at present)—the Neotropical, the Ethiopian, and the Indian—with this northern land surface.

I have ventured to cite one or two instances in which the methods of classification adopted in the "Study of Mammalia" appear to be open to improvement. I trust that I may without offence express a doubt as to what precisely is the meaning of the last part of the following passage :—

"The researches of palæontologists, founded upon studies of casts of the interior of the cranial cavity of extinct forms, have shown that, in many natural groups of Mammals, if not in all, the brain has increased in size and also in complexity of surface foldings with the advance of time, indicating in this, as in so many other respects, a gradual progress from a lower to a higher type of development."

I confess that I do not understand what this "lower" and "higher type of development" refer to. The remarkable thing about the small brains of extinct Ungulata is that, whilst they differ enormously in relative size and in the low development of other features from the brains of living Ungulates, their possessors exhibited no corresponding difference of skeletal structure; so that it appears that the brain has had an independent evolution, advancing in size and complexity from the initial phase of the primitive Ungulate far further than has the general body-structure. The gap in respect of brain between man and the highest apes, accompanied as it is by mere trivial differences of bodily structure, appears to be a less marked case of the same general phenomenon. We may say that the brain in the one case is in a lower and in the other in a higher stage of development; but whether the authors mean this merely, or that the whole animal has passed "from a lower to a higher type of development," and to what kind of morphological doctrine that phraseology belongs, are matters which do not immediately explain themselves.

The only way to write of so large, so comprehensive, and so authoritative a work as the present, is to point out a few matters for discussion which a rapid review of its pages suggests. Such indications of topics on which one would like to know more from the authors of a book of this kind are not fault-findings, but samples of the interest which it awakens in a sympathetic reader.

E. RAY LANKESTER.

FORTY YEARS IN A MOORLAND PARISH.

Forty Years in a Moorland Parish. By the Rev. J. C. Atkinson, D.C.L. (London: Macmillan and Co., 1891.)

THE moorland parish of which Dr. Atkinson writes is the parish of Danby, which lies among the Cleveland Hills, some miles inland from Whitby. Here he has worked as a clergyman for forty-five years. To a man of narrow sympathies and little intellectual curiosity the position might have been trying enough; but in the life of the people, in the aspects of Nature, and in local problems appealing to the antiquary and the historian, Dr. Atkinson has found sources of interest which have never lost their charm. In the present volume he records some reminiscences of the pursuits which have occupied him, and of the impressions which have been made upon him, during all these years; and a very fascinating record it is. He not only has powers of keen and accurate observation, but carries on his researches in a thoroughly scientific spirit; and he is a master of the difficult art of stating problems in a manner that secures attention while they are being gradually solved. His immediate subject is Danby; but if the author had never raised his eyes to look further afield, his readers might soon have felt that he had told them about as much as they wished to know. Facts relating

to a particular locality can never be really understood unless they are brought into connection with kindred facts in other parts of the world. This is constantly borne in mind by Dr. Atkinson, and his ample learning enables him to apply the principle in many different ways; so that, when he is talking about Danby, he is often talking at the same time about wide regions of the British Islands, and even about stages of culture through which the greater part of the human race has passed.

One of the most interesting of the sections into which the book is divided is the one headed "Antiquarian." In Danby, as in Cleveland generally, there are many prehistoric burial-mounds, and a large number of these he has carefully excavated. The only traces of bronze he has discovered are "a few mouldering fragments of very thin plate, found with the unprotected bones of a cremated body, and not sufficient to fill a very small pill-box half an inch in diameter." Nevertheless, the contents of the larger "houes" prove conclusively that they belong to the Bronze Age; and Dr. Atkinson is of opinion that they date from the later part of the period. He has found many vases of the Bronze Age type, some jet beads, two polished axe-hammers, various bone pins, arrow-heads and other objects of flint; and by far the larger proportion of these treasures may now be studied, along with similar treasures recovered elsewhere, in the British Museum. Dr. Atkinson tells with great spirit the story of the more memorable of his explorations; and he has much that is amusing to say about the wonder excited among his rustic neighbours by what seem to them his mysterious proceedings, and about the interest aroused in the minds of those whom he has from time to time induced to help him. Across the ridges between which lie the dales of the district are ancient earthworks, all of which "are defensive against attack from the south, and in no other direction whatever." Of these dykes, which seem to be of the same period as the burial-mounds, Dr. Atkinson gives a full and lucid account, and he offers some suggestive hints as to their relation to other old fortifications in the neighbourhood. He has also an excellent chapter on various pits which have often been described as the remains of "British settlements." There can be little doubt, as he shows, that in reality these pits are the remains of early mining excavations.

Another valuable part of the book is devoted to folk-lore. The belief in witches has not even yet wholly died out in Cleveland; and forty years ago it was still a more or less potent factor in the lives of the people. The author gives some curious instances of the power formerly attributed to witches, and of the means by which their devices were supposed to be thwarted by the "wise men" of the district. He suggests that witches may not always have been mere impostors, but that in some cases they may have been able to exercise the kind of influence to which the phenomena of hypnotism are believed to be due. Even more interesting than the traces of faith in witchcraft are the survivals of "fairy," "dwarf," and "Hob" notions. According to a tale told to Dr. Atkinson by an old woman, there was a farm in Glaisdale where Hob, so long as he was not spied upon, did much excellent work at night. At last some one was curious enough to watch him, and it was thought he would be all the better for "something to hap hissel' wiv." Accordingly a coarse shirt, with a belt or girdle to confine it round his middle, was made for him, and left in the barn where he worked. When he found the gift, Hob broke out in the following couplet:—

"Gin Hob mun hae nowght but a hardin' hamp,
He'll coom nae mair, nowther to berry nor stamp."

Dr. Atkinson was delighted with this couplet, for it preserves three words which had become obsolete forty years ago, and two of which—"berry" and "hamp"—had no actual meaning to the speaker. "Stamp" was the word for "the action of knocking off the awns of the barley previously to threshing it, according to the old practice." "Berry," meaning to thresh, he had been "looking and inquiring for, for years, and looking and inquiring in vain." As to "hamp," he had "never had any reason to suppose that it had once been a constituent part of the current Cleveland folk-speech." The hamp was a kind of smock-frock, gathered in about the middle and falling below the knee, and was at one time the characteristic garment of the English peasant. The word "seems to be clearly Old Danish in form and origin."

There are several chapters which will give pleasure to students of geology and ornithology; and in his notes on weddings, burials, the harvest-home, and holy wells, the author displays much ingenuity in detecting survivals of what were in past times wide-spread customs. In the interpretation of old historical documents, and in the purely descriptive parts of the book, he is equally successful. Some readers, finding so many things to lure them on from the beginning of the work to the end, may be disposed to think that Danby is a very exceptional parish. What is exceptional, however, is not so much the writer's subject as the knowledge and insight which enable him to appreciate, and to make others appreciate, its true interest and significance.

OUR BOOK SHELF.

Anatomy, Physiology, Morphology, and Development of the Blow-fly (Calliphora erythrocephala). Part II. By B. Thompson Lowne, F.R.C.S., F.L.S., &c. (London: R. H. Porter, 1891.)

THE general features of this study in insect anatomy have already been noticed (NATURE, vol. xliii. p. 77). Part II. describes the exoskeleton in considerable detail, and contains many useful and elaborate figures. Plate v. and the accompanying explanations give the author's views upon the morphology of the insect-head. The pre-oral part he regards as developed from three bladder-like swellings, to which correspond three primary divisions of the cephalic nerve-centres. The post-oral part is supposed to arise by the fusion of three jaw-bearing segments. The terminal portion of the proboscis is probably developed, according to Mr. Lowne, from the first, and not from the second pair of maxillæ. The description of the mouth-parts is very full, and the figures are extremely good.

The thoracic skeleton is also minutely described, perhaps over-minutely, seeing that, in our author's words, "a classification of the various sclerites indicative of their morphological significance is not possible with our present knowledge." Other careful descriptions by special students show that it is easy to interpret the complex thoracic structures in a different way from that here adopted.

Excellent figures are given of the legs, feet, and wings,

and the description of the foot of the fly is of very special interest. The wing-joint is described with great care and thoroughness, in connection with the mechanics of flight.

Comparisons between insect and vertebrate structures are made with great boldness. One example will probably astonish common-place morphologists. Weismann observed that the femoro-tibial part of the fly's leg forms at first a mere lateral prominence, which is converted by segmentation and constriction into a bent knee, the upper part yielding the coxa and femur, the lower part the tibia. Mr. Lowne confirms this account, and illustrates it by figuring five stages (Fig. 34). Next he compares the lateral prominence to the exopodite of a biramous limb. Then he adopts Dr. Gaskell's suggestion that the limbs of an Arthropod may correspond to the visceral arches of a Vertebrate. In the following sentence we reach the climax. "The double character of the embryonic appendages in the Crustacea, and in the maxillæ of insects, as well as in the thoracic limbs of the rudimentary fly-nymph, is certainly very suggestive of the double character of the pterygomaxillary arch, or even of the hyomandibular in vertebrates."

So much conscientious labour has been bestowed upon this treatise, and it is so useful to the student of insect anatomy, that it is a pity to see the text encumbered with discussions which, to avoid dogmatism, we will merely call extremely hazardous. Would it not be better to bring out such views in another place, and leave the *magnum opus* free of doubtful matter?

When all deductions have been made, the book must be counted a valuble addition to the literature of the subject. L. C. M.

Races and Peoples: Lectures on the Science of Ethnography. By Daniel G. Brinton. (New York: N. D. C. Hodges, 1890. Sold by Kegan Paul, Trench, Trübner, and Co.)

THE lectures of which this book consists were delivered at the Academy of Natural Sciences, Philadelphia, early in 1890. They present a good general view of the leading principles of ethnography, as these are understood by the author. He begins with a discussion of what he calls the physical and psychical elements of ethnography, next treats of the beginnings and subdivisions of races, then takes in order the divisions in which he arranges the various groups of mankind, and finally deals with problems relating to "acclimation," amalgamation, and the influence of civilization on savages, and offers some suggestions as to the destiny of races. The human species seems to him to include five races—the Eurafrican, the Austafrican, the Asian, the American, and insular and littoral peoples. Each of these is subdivided into branches, stocks, and groups; and an effort is made to define the traits which, according to Dr. Brinton, the members of each race have in common. It is not always easy to understand the principle of his classification. The Eurafrican race, for instance, includes the following groups: Libyans, Egyptians, East Africans, Arabians, Abyssinians, Chaldæans, Euskarians, Indo-Germanic or Celtindic peoples, and peoples of the Caucasus. These peoples are all white; and Dr. Brinton thinks we may also say of them, "hair wavy, nose narrow." But the differences by which they are separated from one another are, at least in some cases, so profound, that it is extremely doubtful whether we are warranted in attributing to them a common origin, except in the wide sense in which a common origin is attributed to humanity generally. So long, however, as Dr. Brinton's classification is understood to be merely a convenient way of bringing together great masses of facts, it may be of considerable service to students. The book embodies the results of much careful research, and is written in a clear and vigorous style.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Crystals of Platinum.

SINCE writing a note on this subject to NATURE (vol. xliii. p. 541) I have found that it is by no means requisite to use topaz in order to obtain crystals of platinum from a ribbon of that metal heated by a current. Thus the ribbon may be dusted over with quartz dust, and if the temperature be raised to that at which this is slowly melting (1430° C. about), crystals of platinum gather upon projecting points on the quartz. Doubtless the presence of fluorine will facilitate, as described in my former letter, the volatilization of the platinum, but there is little doubt that at a temperature some 300° below its melting-point (1750°; Violle) there is a slow volatilization of the metal due either to heat pure and simple, or to this in conjunction with the presence of a current as in high vacua.

To put the possibility of chemical action out of the question, I weighed a clean ribbon of pure platinum, 9 centimetres in length, and passed such a current through it, for 30 minutes, as raised it to nearly the melting-point of palladium (1500°; Violle). The first weighing was 0·0700 grammes, the second (after heating) 0·0688, indicating a loss of 1·7 per cent. of its weight.

I find that Prof. A. S. Törnebohm, of Stockholm, has described in a recently-published paper (*Aftryck ur Geol. Fören. i Stockholm Förhandl.*, Bd. 13, Häft 2, 1891) cubical crystals of platinum formed by the action of chlorine gas upon platinum black at a high temperature. The figures illustrating his paper depict crystals similar to those obtained by the present method.

J. JOLY.

Physical Laboratory, Trinity College, Dublin.

Porpoises in the Victoria Nyanza.

IN Dr. Carl Peters's "New Light on Dark Africa," he speaks of "some large gray-bellied porpoises tumbling about" in Lake Victoria Nyanza, "and rollicking in the tepid flood" (see p. 445).

I should be glad to know whether there is any other authority for the occurrence of a Cetacean in this lake. It is possible, but very improbable, as no Cetaceans are known to occur in the Nile, or other African fresh waters, although there has been a report of the Manatee being found in the Shári, which runs into Lake Tchad (see Barth, "Reisen," iii. p. 289), and the Manatee also occurs in the Niger. P. L. SCLATER.

The Zoological Station at Naples.

IT is desirable that the names of any biologists who wish to make use of the British Association Table at the Naples Zoological Station, during the year commencing in September next, should be in the possession of the Committee before the meeting of the British Association at Cardiff.

Intending applicants are therefore requested to send in their names, and a statement of the nature of the work they propose to undertake, before June 30, to me as Secretary to the Committee. W. PERCY SLADEN.

13 Hyde Park Gate, S.W., June 6.

A BRITISH INSTITUTE OF PREVENTIVE MEDICINE.

ON Friday, June 5, Sir Michael Hicks-Beach received in one of the large rooms of the Victoria Hotel, Northumberland Avenue, an unusually numerous and influential deputation on behalf of the British Institute of Preventive Medicine. Sir Michael Hicks-Beach was accompanied by Sir Henry Calcraft, K.C.B., Secretary to the Board of Trade, Mr. Courtenay Boyle, C.B., and Mr. Walter J. Howell.

Among the members of the deputation were the Duke of Westminster, the Earl of Feversham, Sir Frederick Abel, Sir F. Bramwell, Sir John Lubbock, Sir Benjamin

Baker, Dr. Farquharson, M.P., Sir William Thomson, Sir James Bain, Sir Joseph Fayrer, Sir Philip Magnus, Sir Jacob Wilson, Prof. Dewar, Sir Douglas Galton, Sir Archibald Geikie, Sir William Houldsworth, M.P, Sir George Humphry, Mr. Haldane, Q.C., Mr. Seager Hunt, M.P., Sir Guyer Hunter, M.P., Prof. Ray Lankester, Prof. Norman Lockyer, Mr. Blundell Maple, M.P., Sir Lyon Playfair, M.P., Sir Robert Rawlinson, Sir Henry Roscoe, M.P., Sir George Gabriel Stokes, M.P., Prof. Burdon Sanderson, Sir Henry Trueman Wood, Prof. Victor Horsley, Dr. Armand Ruffer, Mr. Priestley, Sir Henry Simpson, and other members of the Royal, the Linnean, and other scientific Societies.

The following letters were read from Prof. Tyndall and Prof. Huxley :—

"*Hind Head, Haslemere, June* 3, 1891.

"MY DEAR SIR JOSEPH,—The battered remnant of four deadly assaults, I am still a prisoner in my bed. Were I a free man, I should deem it a privilege to join your deputation to Sir Michael Hicks-Beach on June 5. I entirely sympathize with the movement.

"Let me here record a small experience of my own. Last summer, while crossing from Dover to Calais on my way to the Alps, I noticed, huddled up in a corner of the steamer, a poor English boy. He seemed lonely and depressed, and I spoke to him. 'Where are you going, my boy?' I asked. 'To Paris,' was the reply. 'And what are you going to do in Paris?' 'Well, sir,' said he, 'I have been badly bitten by a mad dog, and I am now on my way to Mr. Pasteur, who I hope will save my life.'

"The case prompted sad and bitter musings. Here was wealthy England, with the amplest means at her disposal, with some of her ablest men ready to investigate and apply those means, insanely forbidding such investigation, and compelling her children to resort to a foreign country to have themselves rescued from the most horrible of deaths. As I spoke to the lad, the virulent rabic virus was probably already in his blood, and his chance of life depended on the promptness with which Pasteur's vaccine could be introduced to combat and destroy that virus. Every hour lost in the collection of money for the boy's journey and in making arrangements with Pasteur for his reception—every hour lost in his transport from England to France—was so much time given to the virulent virus to pursue its fatal work, and to ruin the chances of the boy's rescue. This is the state of things to which we in England are forced to submit; this is the condition to which we are reduced, through the deference paid by English statesmen to a noisy and an ignorant faction.

"But while the investigation and treatment of hydrophobia confer immortal honour on Pasteur, this malady is but a small item in the array of disorders now demanding investigation. Suspected from time to time by men of genius in the past, the fact that all communicable diseases are due to micro-organisms, which increase and multiply after the manner of living things, has, in the opinion of our first authorities, been now reduced to demonstration. Your proposed institute is to be devoted to the investigation of such organisms—to the study, that is, of the science of bacteriology. In regard to questions of life and health, such an institution is the most pressing need of England at the present hour. A good deal of the weary time which I have been forced to spend in bed during the last six months has been devoted to making myself acquainted with what is being done by the staff of the Hygienic Institute of Berlin, an institute of which the German nation may well be proud. I have occupied myself in drawing up an account of the researches recently carried out in connection with the institute. In regard to our most fatal disorders, these researches will effect a revolution, not only in public knowledge, but also in the thoughts and practice of medical men. It would, in my opinion, be a lamentable mistake on the part of an English statesman to place himself in official antagonism to the eminent and illustrious men who on June 5 will advocate the founding of a similar institute in England.

"It is, I think, fortunate that you have in Sir Michael Hicks-Beach a statesman not likely to fall into the extravagances of sentimentalism. The overwhelming preponderance of English intellect will be represented by the deputation. He may rest assured of it that this preponderance will become more and more conspicuous, until finally the misguided opponents of a true philanthropy will cease to engage the attention, much less enlist the sympathy, of the English people.

"Believe me, dear Sir Joseph, most faithfully yours,

"JOHN TYNDALL.

"Sir Joseph Lister, Bart."

"*Hodeslea, Eastbourne, June* 2, 1891.

"DEAR SIR JOSEPH LISTER,—I am very sorry that I am unable to join your deputation on June 5.

"If I could have been with you, I think I should have asked to be permitted to point out to the President of the Board of Trade that medical science is not excepted from the rule which holds good for other branches of natural knowledge, and that it can be advanced only by reasoning based upon observation and experiment, and constantly controlled by both, especially by the latter.

"Further, that by working in this fashion a marvellous improvement of medical science has been effected during the last half-century, and that the harvest of what Bacon called 'fruits,' which is now waiting for the gatherer, might fully occupy half a dozen such institutes as that in which we are interested.

"Starting from the unquestionable facts that the work we propose to undertake is of supreme public utility, and that the number and extent of the problems of pathology are enormously great in proportion to any existing means of dealing with them, I should have ventured to ask why we should be refused the only privilege we seek—namely, that official recognition by the Board of Trade which will afford the institute security against the possible misuse of its funds in future?

"No doubt, however, all these points will be much more effectually put by yourself and other members of the deputation.

"I am yours very faithfully,

"T. H. HUXLEY.

"Sir Joseph Lister, Bart., F.R.S."

Sir Henry Roscoe, M.P., in introducing the deputation, said that it represented not only the whole body of medical men in this country, but also, without exception, all the scientific elements amongst scientific men, and also a large number of others who were interested from the national point of view in the establishment of an institute of preventive medicine for this country, and for which it was proposed to obtain incorporation under the Board of Trade. He need not go into the question as to the national importance of an institution of this kind. There was no civilized country in Europe, and scarcely anywhere else, in which this subject had not awakened the interest and claimed the attention, not only of the scientific men, but also to a great extent of the Governments of those countries. What they asked was that Sir Michael Hicks-Beach would be good enough to enable them to found and to carry on a British Institute of Preventive Medicine, analogous and of a similar form to those great institutes which existed in France, Germany, Russia, and in a great number of other countries. They were sorry to find that the object which they had in view and the request that they made to Sir Michael had not met altogether with the success which they had hoped. They learnt from the answer which he had given to Major Rasch in the House of Commons that the refusal to grant what they requested was based on objections received by the Board of Trade. They merely asked that the institution should be registered under the Limited Company Act, with the omission of the word "limited," in order to impress the public with the fact that the institute was not established for the purpose of gain, but purely for sanitary and scientific objects. The objections were based upon the fact that a part of the work would include experiments on animals. In reply to this they had the opinion of counsel that the Board of Trade had only to satisfy themselves that the object was charitable, and that the promoters were persons whose position was a sufficient guarantee of the high character of the proposed institute.

Sir Joseph Lister said the object of their deputation was to request Sir Michael Hicks-Beach to reconsider his decision, and to grant the licence under the Board of Trade which was really, as it would seem, almost essential to the prosperity, if not indeed to the very existence, of the institute. It was essential, in order that they might hold money in trust, that they should be incorporated. They had been promised a large sum of money, the receipt of which would be essentially dependent upon their incorporation, and if they were incorporated as a limited liability

company they would not be able to appeal to the public for funds with any success. In the first place, their institution would have a mercantile character, which would tend to repel subscribers; and they had the opinion of counsel that under such circumstances it would be in the power of the subscribers at any time to agree to have the institute wound up and the funds divided amongst themselves. To appeal to the public for subscriptions, therefore, under these conditions would be absolutely hopeless. On the other hand, if the licence were granted there could be inserted by the Board of Trade a condition that the funds of the institute should be used only for scientific and charitable objects, and in that way their position would be perfectly secured. The only practical alternative, if it was still thought right to refuse their request, would be that they should be incorporated by Act of Parliament—a process which would involve very great loss of time and also very serious expense. The importance of the object which they had at heart was one which he thought need hardly be much dwelt upon. Preventive medicine based upon bacteriology was a matter of comparatively recent experience, but it had been making gigantic strides, and every year and almost every week they were learning of new triumphs achieved in the discovery of the essential nature of disease and of the means of preventing such disease. He might be permitted perhaps to refer to one or two illustrations of the value of the work carried on at such institutes both to man and to the lower animals. The work done by M. Pasteur for the rescue of those bitten by mad dogs from the horrible death of rabies was bearing invaluable fruits. It had been estimated that within four years at the Pasteur Institute 12,000 lives had been saved. During the last six years 403 British subjects had been treated, and out of those 403 only seven had died. If they took into account the loss of time involved in making arrangements for going to Paris, and considered also that the essence of M. Pasteur's treatment was to intercept the disease before it arrived at the vital organisms in the brain, they might anticipate a large amount of success if they had the means in this country of having the same treatment carried out. From Germany had come the discovery of what was termed tubercle bacillus—that was to say, the micro-organism which was the essential cause of tubercle, the greatest physical scourge that afflicted the human race. To establish that that bacillus was really the essential cause of this disease in all its diverse forms required a large amount of investigation such as could only be carried on in institutes like that which they desired to see established. That the institute would be of great benefit also with regard to diseases of the lower animals might be seen from the discoveries made as to the cure of anthrax by M. Pasteur, and as to the treatment of another affliction known as "quarter evil" by a scientist of Lyons. Various bacteriological laboratories had been already established in the British Islands, but it was universally allowed that none of those existing was in the least equal to a great institute such as they desired to see established. One proof that such was the case was presented by the fact that our best workers in these subjects had been going continually to Paris or to Berlin for the superior advantages that they could obtain there. He ventured to think that the mass of educated opinion represented by the deputation was surely more deserving of attention than the views of those who, with whatever excellent intentions, had petitioned against their scheme. The truth was that objections were made because the petitioners objected altogether to the performance of experiments upon living animals, and not because they thought that there was already sufficient opportunity for work of this kind. If those petitioners knew how very small was the amount of suffering really inflicted upon the animals in such an institute, and how scrupulous was the care taken to avoid all needless pain, they would not (at least, the great majority of them would not) have made the opposition that they had made. He even doubted whether the question of their being likely to perform experiments upon living animals was one which the Board of Trade had any fair reason to occupy itself with. The licensing of places for the performance of such experiments, and the licensing of individual experimenters had always rested with the Home Secretary. Foreign institutions such as that which they desired to see established had been largely endowed by the State, and he did not relinquish the hope that our Government might at some future time see its way to give them substantial aid. But, however that might be, they ventured to hope that no department of this Government would oppose any unnecessary obstacle to an enterprise which had for its sole object the welfare of humanity, the health of mankind and the lower animals, and the general progress of the public weal.

Sir Lyon Playfair, M.P., said that experiments on living animals had been sanctioned by Parliament, which had intrusted the Home Secretary to make suitable restrictions for the carrying out of the operations. The proposed institute was promoted differently from those in foreign countries, which were being founded by the State, and the deputation only asked to be allowed to associate for a purpose recognized by Parliament, and with such restrictions as Sir Michael Hicks-Beach or the Home Secretary thought proper to impose.

Prof. Dewar spoke of the importance of the proposed institute from a chemical point of view, and Dr. Ray Lankester and Sir James Crichton Browne also spoke.

Sir M. Hicks-Beach, in reply, said:—I hope that it is not through any fault of mine that those who have arranged for this deputation have not come to me in the ordinary numbers of a deputation, but have thought it necessary for their object to summon from different parts of the country so very large a number of gentlemen who are very actively engaged, and whose time must be very valuable, not only to themselves, but also to the public. I am not disposed to be influenced in any matter by the mere numbers of a deputation. It would be perfectly possible for you and for those who differ from you on the other side to fill a very much larger room than this. I think the deputations should be weighed rather than counted, and if half-a-dozen of those who are now present had come to me saying what has been said to-day, and authorized to speak on behalf of all of you, I can assure you that I should have attached as much weight to their arguments as I can do now. But, of course, I accept your presence here as a strong testimony to the great interest that you feel in this subject. I am sorry to confess to have differed from so many gentlemen of such eminence as those who have supported this movement, and to have found myself unable to grant the application of the British Institute of Preventive Medicine for permission to register the Association without the addition of the word "limited." It is only due to you that I should explain, as shortly as I can the reasons which induce me to arrive at that decision. Now, the section of the Act of 1867, under which you ask me to act, lays down two preliminary requirements which must be proved to the satisfaction of the Board of Trade—first, that the Association shall be formed for one of several purposes, such as, for instance, that of promoting science, or some other useful object; secondly, that the profits or income will be applied to promote the objects of the Association, and that the payment of dividends will be prohibited. Now, I will assume that you have complied with both these requirements; I say nothing to the contrary. But the proof of such compliance does not, in my opinion, compel the Board of Trade to act on the section. Something has been said to-day to the effect that you have obtained counsel's opinion that it does compel the Board of Trade so to act. I have taken another view—I admit without legal advice. If you will place before me the opinion upon which your view is based, of course I shall very carefully consider it, and myself obtain legal advice upon that point, because I view it as an important point, as you will see from what I am going to say. I have considered, as I said, that the section of the Act only empowers the Board of Trade to act, and leaves it to the Board of Trade to decide whether the licence shall be granted or not; and if granted, whether any conditions or regulations should be imposed and inserted in the memorandum and articles of association. It therefore seems to me that the Board of Trade could hardly grant such a licence without expressing approval, by the mere fact of the grant, of the Association to which it is granted. In your case I think I have no right to express such an approval, because, if I rightly interpret Clause 3*a* of your memorandum, I understand—and I also gathered from what has been said to-day—"that experiments on living animals calculated to give pain," to quote the words of the Act of Parliament, are included among your objects; in one word, that vivisection would be part of your work. Now, this is a subject which the Legislature by the Cruelty to Animals Act, 1876, has placed under the control, not of the Board of Trade, but of the Home Office. By that Act, as you know, vivisection is made illegal except by licence from the Home Office, and under the most stringent regulations, including inspection by inspectors of the Home Office. I assume that when you had established this institution, supposing my licence were granted, an application would be made to the

Home Office for a licence or licences for vivisection on the premises of the institute for some one or more of its members. It seems to me that the Home Secretary would have fair ground to complain of my action, if in a matter of such admitted difficulty, rousing as it does the strongest feelings of both sides, I did anything which would enable you to go before him, to whom Parliament has intrusted this subject, with the stamp of approval as it were from another Government department which has nothing to do with the subject at all. Now, I hope I have put that shortly and plainly. What are your alternatives? You have said something to me on this subject to-day. You can, of course, if you choose, remove from your objects anything which could bring you within the Cruelty to Animals Act, 1876. If you did that, my objections would be entirely removed. You could, if you chose, form yourselves as a Society, vesting your property in trustees; associate yourselves under the Companies Act as a limited company, inserting a proviso that you should pay no dividends. Now, I should like to have before me the reasons in writing which have been urged to-day why none of these courses would meet your views. I can only say in conclusion that I have endeavoured to put to you the difficulty which I feel; that I will carefully consider what has been said to-day; and any documents which the promoters of the Association wish to place before me to enforce the views which have been expressed I shall be glad to receive.

Sir John Lubbock, in moving a vote of thanks to Sir Michael Hicks-Beach, said that Sir Henry Roscoe had authorized him to say that the further information which had been asked for should be furnished to the Board of Trade. Vivisection was after all a very small part of the question before them, unless, indeed, vivisection was to be understood as applying to the bacteria. He would venture to remind Sir Michael that although Acts of Parliament might prevent them from destroying the bacteria, they could not prevent the bacteria from destroying human beings, and it seemed almost a significant fact that no members of the community, as he knew to his own cost, had suffered more from them than members of the House of Commons. He had no reason to suppose that bacteria suffered at all, though human beings suffered very much from the bacteria. The bacteria were now experimenting upon them, and all that they asked was that they should be allowed to defend themselves from the bacteria. Something had been said about agriculture, and he believed that such an institute as this would add much to the prosperity of agriculture and probably of manufactures and of commerce. As regarded the technical points which had compelled the right hon. gentleman to adopt the course which he had taken, he thought if Sir Michael went into the matter he would find at least two precedents in which an opposite line had been taken in cases where vivisection was practised.

The President—I ought to mention that any of the precedents which have been mentioned I should like to have placed before me.

The deputation then withdrew.

EARTH-CURRENTS AND THE ELECTRIC RAILWAY.

A WELL-MARKED case of interference with the earth-currents recorded at the Royal Observatory, Greenwich, due apparently to the working of the new Electric Railway, having recently been experienced, of which some account might prove to be interesting to electricians, the Astronomer-Royal has kindly allowed me to communicate for publication in NATURE some particulars in regard thereto.

It is known that for many years past a continuous photographic register of earth-currents has been maintained at the Royal Observatory. There are two circuits. For one circuit the earth-plates are at Angerstein Wharf (A.W.), on the southern bank of the River Thames, near to Charlton, and at Lady Well, Lewisham (L.W.); for the other circuit the earth-plates are on Blackheath (B.), at the south end of the North Kent Railway tunnel, and at the North Kent East Junction (N.K.E.J.) of the South-Eastern Railway, the junction of the North Kent and Greenwich lines. The earth connection is in each case made by an independent copper plate; these plates are used only for the earth-current lines, no other wires being attached thereto. From the A.W. earth-plate the wire passes by the South-Eastern Railway lines to the Greenwich Station, thence underground to the Royal Observatory recording apparatus, returning underground to the Greenwich Station, and thence by the railway to the earth-plate at L.W. Similarly for the Blackheath–North Kent East Junction circuit. The direct distance between the A.W. and L.W. earth-plates is 3 miles, and between the B. and N.K.E.J. earth-plates about 2½ miles. The azimuth of the A.W.–L.W. line, reckoning from magnetic north towards east, is 50°; the azimuth of the B.–N.K.E.J. line, reckoning from magnetic north towards west, is 46°. Registration is effected in the usual way. In each circuit there is a horizontal galvanometer the needle of which carries a small mirror; on this the light from a fixed gas-lamp falls, and, reflected therefrom, finally reaches the revolving cylinder as a small spot of light.

Some few particulars concerning earth-current motions generally may perhaps be given. It has been found that all cases of disturbance of the magnets are accompanied by earth-currents, more or less powerful as the magnetic disturbance is more or less pronounced. The correspondence is most complete. No sudden marked motion of the magnets ever occurs without corresponding active earth-currents, as may be seen by the plates (copies of the various registers) given in the several Greenwich volumes since the year 1882. On days on which the magnets are free from disturbance, and show only the ordinary diurnal change, earth-currents are very feeble.

Before speaking of the recent case of interference, we may devote a few words to the description of a previous case in which the interference was much less marked in character, although, with some intermissions, otherwise very persistent. Some five years or more ago it was remarked, in the A.W.–L.W. register, that at one part of the day a slight dislocation of the trace occurred, in no case indicating a change of potential of more than 0·1 volt, frequently much less: after some hours the trace as suddenly returned to its normal position. This was not discernible every day, but still frequently, and still continues. Nothing has been perceived in the other circuit. On examining the A.W.–L.W. records for a number of months, it appears that at all parts of the year the dislocation occurred some three-quarters of an hour after sunset, and the return to normal position at about the same interval before sunrise. The cause of the interference has not been traced, although it has been conjectured that in some way it may be connected with electric lighting in the vicinity of the A.W. earth-plate.

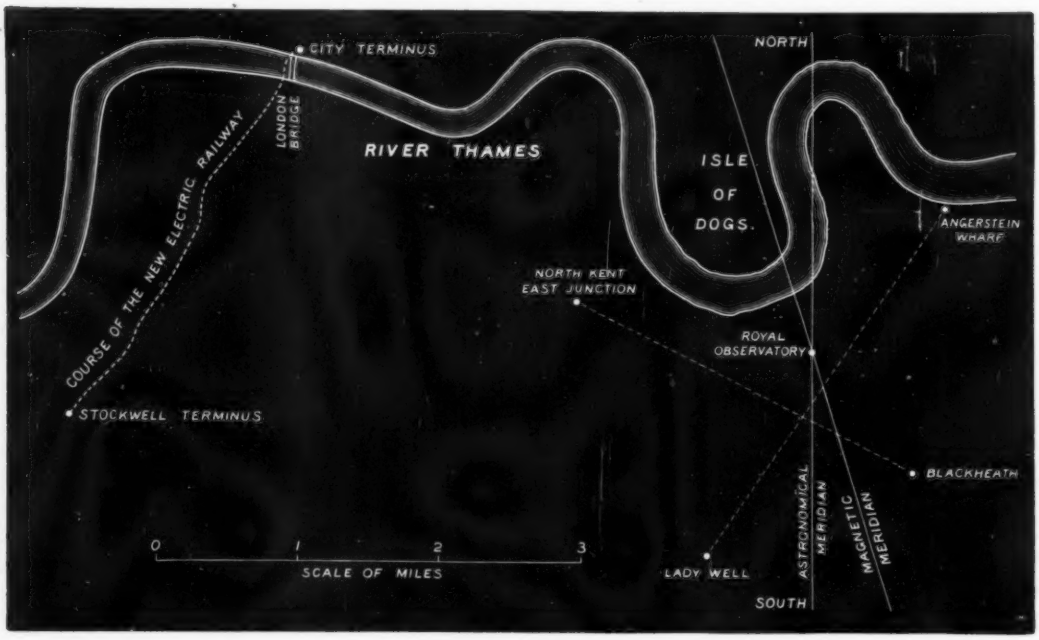
We now come to the recent much more serious case of interference. Towards the end of last year anomalous appearances began to be observed in both of the earth-current registers, not continuously but in a somewhat irregular manner. Now, however, for some months past, these new interruptions have settled down into a regular order. What is perceived is that the interference in question, causing a continuous vibration of the registering needles, commences shortly before 7h. in the morning, goes on all through the day, terminating shortly after 11h. in the evening. This went on for several months on week-days only, ceasing on Sundays, nothing being seen after 11h. p.m. on Saturday, until 7h. a.m. on Monday. But on Sunday, April 5, and on every succeeding Sunday to the present time, the interference has been experienced also on a portion of the Sunday, commencing at about 1h. p.m., and terminating usually at 10h. p.m. or shortly afterwards. Various experiments were made with the view of discovering the cause of these anomalous appearances, but without definite result. Quite recently, Mr. Leonard, the telegraphic superintendent of the South-Eastern Railway, to whom the Observatory is much indebted for considerable assistance in many matters connected with the earth-current work, was led to suggest

that the exceptional appearances were most probably due to the influence of the new Electric Railway, three miles in length, and having terminal stations in the City and at Stockwell. A comparison being made between the observed times of interference with the earth-current registers, and the published times of running of the Electric Railway trains, it was found that these were simultaneous. Further, in the early part of the year, during the period in which the earth-current registers were free from interference on Sunday, there were correspondingly no Sunday trains. But on Sunday, April 5, it appears that trains commenced to run on Sunday afternoon, the same day that Sunday interference was first noticed at Greenwich. and these Sunday afternoon trains have been since continued. The whole matter is better seen in the annexed tabular statement:—

Times of interference with earth-current registers at the Royal Observatory, Greenwich.	Train service on Electric Railway.
On week days.	On week days.
From shortly before 7 a.m. until shortly after 11 p.m.	First train from Stockwell 6.40 a.m. ,, ,, City ... 6.50 a.m. Last train from Stockwell 10.46 p.m. ,, ,, City ... 10.58 p.m.
On Sundays, commencing April 5.	On Sundays, commencing April 5.
From about 1 p.m. until 10 p.m. or shortly afterwards.	First train from Stockwell 1.0 p.m. ,, ,, City ... 1.5 p.m. Last train from Stockwell 9.30 p.m. ,, ,, City ... 9.30 p.m.

The line of the Electric Railway runs from about north-east to south-west magnetic, or more accurately the azimuth of the line, reckoning from magnetic north towards east, is about 50°. The nearest earth-plate to the railway is the N.K.E.J. plate, which is distant from the railway, in a perpendicular direction from it, about 2½ miles.

The correspondence so far as the comparison goes is complete. During the periods of interference the registering needles at the Observatory are in continual vibration. Whether the impulses are in one direction only or in both directions, and what is their frequency, cannot be readily determined from the registers. Eye observation of the needles may perhaps reveal something to us on these points. The abnormal excursions of the needles indicate a change of potential varying from a small fraction of a volt to perhaps the one-third of a volt or more. When any marked earth-current action arises, the interference becomes in some degree neutralized, and less marked in character.



It was found in the course of previous experiments, that when, instead of employing the complete A.W.–L.W. circuit, the A.W. branch only was allowed to register, by putting the wire to earth at Greenwich, the amplitude of vibration of the needle was not perceptibly changed, neither was it changed when the L.W. branch only was allowed to register. Correspondingly, when the B. branch alone of the B.–N.K.E.J. circuit was allowed to register, the vibration was much diminished, whilst with the N.K.E.J. branch alone registering it was much increased.

WILLIAM ELLIS.

THE ANNUAL VISITATION OF THE ROYAL OBSERVATORY.

THE Report presented by the Astronomer-Royal this year is of more than usual interest. The first part deals with proposed new buildings.

It has been decided that the museum or storehouse for portable instruments and apparatus should be built so as to form the central octagon of a future cruciform structure in the South Ground, which would accommodate the physical branch of the Observatory, and would carry the Lassell equatorial and dome at such a height above the ground that the neighbouring trees would not interfere with the effective use of the instrument. The building

for the Museum was commenced at the beginning of March. In consequence of a recent decision of the Admiralty to largely increase the number of chronometers and deck watches for the Navy, additional accommodation for chronometers is required immediately, the space in the present chronometer room being insufficient even for existing requirements.

In other directions the difficulty of providing in the existing Observatory buildings for the accommodation of the increasing staff and of the accumulating material is severely felt, and it is very desirable that the pressure on the space available should now be relieved by means of a comprehensive scheme, which would supply a suitable fireproof brick building to replace the wooden sheds and huts which now disfigure the Observatory grounds, and to provide for the expansion which has taken place in late years, and which may be expected to continue in the future.

To provide for the efficient working of the 28-inch refractor about to be mounted on the south-east equatorial, the Admiralty have authorized the construction of a new iron-framed dome, 36 feet in diameter, to be erected on the south-east tower in place of the existing wooden drum, which, as mentioned in the last Report, has been so much strained in the course of thirty years, that there is great difficulty in turning it. An attempt was made to render the existing dome more serviceable by bolting the framework together more thoroughly, and by substituting properly turned spheres for the cannon-balls, but though the dome is not now liable to stick fast as formerly, it is still very difficult to turn, and cannot be considered serviceable. The new 36-foot dome, which is being constructed by Messrs. T. Cooke and Sons, is of peculiar form, adapted to the conditions of the case, the diameter being greater than that of the tower on which it is erected.

A photographic telescope with 9-inch object-glass by Grubb, and a prism of 9 inches diameter by Hilger, have been generously presented to the Royal Observatory by Sir Henry Thompson. The telescope has been mounted on the Lassell telescope as a photoheliograph, to give 8-inch pictures of the sun; a camera with Dallmeyer doublet (from photoheliograph No. 4), and an exposing shutter, specially designed to give very short exposures, being attached to it.

Six more electric hand lamps and an Ampère gauge (Sir W. Thomson's) have been purchased.

In view of the advantage resulting from the use of electric lighting for the photographic equatorial and for other instruments, the Astronomer-Royal considers it very desirable that an electric light installation should be provided for the Observatory, so that this method of lighting, which is specially adapted to the requirements of an observatory, may be applied to the instruments generally. The system now in use, of charging storage cells from primary batteries, is necessarily extravagant, and it does not admit of the desired extension.

With regard to the work done, the following statement shows the number of observations made with the transit-circle in the year ending May 10, 1891:—

Transits, the separate limbs being counted as separate observations	6036
Determinations of collimation error	307
Determinations of level error	390
Circle observations	5789
Determinations of nadir point (included in the number of circle observations	387
Reflection observations of stars (similarly included)	593

For determining the variation of personal equation with the magnitude of the star, 324 transits, not included in the above, have been observed. The apparent magnitudes of the stars are altered by placing a wire gauze screen in front of the object-glass of the telescope, and part of a transit is observed with clear aperture, part with obscured. The comparison of the two results gives the difference of personal equation for a definite change of magnitude. It appears that all the four regular observers record the times of faint stars later than bright, the difference per magnitude being about $0^s{\cdot}015$.

Altazimuth.—The total number of observations made in the year ending May 10, 1891, is as follows:—

Azimuths of the moon and stars	253
Azimuths of Mark I.	123
Azimuths of Mark II.	193
Zenith distances of the moon	118
Zenith distances of Mark I.	124
Zenith distances of Mark II.	188

Reflex Zenith Tube.—Since the date of the last Report, 14 double observations of γ Draconis have been made and completely reduced to the end of 1890. M. Lœwy's recent work seems to show that the determination of the constant of aberration with this instrument is more trustworthy than had been supposed; though the circumstance that the observations give a negative parallax for γ Draconis suggests that there is some unexplained source of error.

Sir H. Grubb reports that the object-glass and tube of the 28-inch refractor are now practically ready for mounting; but the Astronomer-Royal proposes to delay this operation until the completion of the new dome on the south-east tower mentioned in the first section of this Report.

Work with the 13-inch photographic refractor was seriously delayed by the accident to the driving-clock, and, later, by the illness of Mr. Criswick; but 81 stellar photographs have been taken, all of which must be regarded as more or less experimental. Ferrous oxalate development was used throughout, and all the plates were photographically impressed with the *réseau* kindly supplied by Prof. Vogel. The exposures have varied from a few seconds to about an hour; and trails have been taken both on the equator and near the pole to test the adjustment for orientation. Several different kinds of plates have been used, including Cramer, Seed, Paget, Star, Mawson and Swan, and Ilford; and on the whole the choice seems to lie between the Star and the Ilford plates.

Spectroscopic and Photographic Observations.—For determination of motions of approach or recession of stars, 286 measures have been made of the displacement of the F line in the spectra of 31 stars, and 14 of the *b* line in the spectra of 6 stars, besides comparisons with the spectra of Mars, the moon, the sun, or the sky, as a check on the general accuracy of the results. The series of observations with the 12¾-inch refractor is now practically completed, and the results are under discussion. An examination of those for the 21 stars most frequently observed shows that there is a systematic error depending on the hour angle, thus necessitating a correction for the position of the spectroscope at the observation.

In the year ending May 10, 1891, photographs of the sun have been taken at Greenwich on 224 days, and of these, 483 have been selected for preservation, besides 18 photographs with double images of the sun for determination of zero of position.

Magnetic Observations.—The following are the principal results for the magnetic elements for 1890:—

Mean declination	17° 28′·6 W.
Mean horizontal force	3·9546 (in British units). 1·8234 (in metric units).
Mean dip	67° 21′ 19″ (by 9-inch needles). 67 22 53 (by 6-inch needles). 67 24 24 (by 3-inch needles).

Meteorological Observations.—The continuous registration of meteorological phenomena has been maintained without interruption, except for four days in February when the old thermograph and shed in the magnetic ground were dismounted, and the new thermograph and

shed were transferred from the South Ground to the position formerly occupied by the old instrument, to make way for the new buildings in the South Ground.

The mean temperature of the year 1890 was 48°·6, being 0°·6 below the average of the preceding 49 years. The highest air temperature in the shade was 82°·8 on August 5, and the lowest 13°·1 on March 4. This latter is the lowest temperature registered in March since 1841, being the same us that recorded on March 13, 1845. The mean monthly temperature in 1890 was below the average in all months excepting January, March, May, and September. In December it was below the average by 10°·0, and in January above by 5°·2.

The mean daily motion of the air in 1890 was 272 miles, being 10 miles below the average of the preceding 23 years. The greatest daily motion was 837 miles on January 26, and the least 32 miles on August 6. The greatest pressure registered was 14·5 pounds on the square foot on January 26.

During the year 1890 Osler's anemometer showed an excess of about three revolutions of the vane in the positive direction N., E., S., W., N., excluding the turnings which are evidently accidental.

The number of hours of bright sunshine recorded during 1890 by the Campbell-Stokes sunshine instrument was 1255, which is about 35 hours below the average of the preceding 13 years, after making allowance for difference of the indications with the Campbell and Campbell-Stokes instruments respectively. The aggregate number of hours during which the sun was above the horizon was 4454, so that the mean proportion of sunshine for the year was 0·282, constant sunshine being represented by 1.

The rainfall in 1890 was 21·9 inches, being 2·7 inches below the average of the preceding 49 years.

The winter of 1890–91 was remarkable for a long period of exceptionally cold weather which commenced on November 25, 1890. From this day till January 22 the mean temperature on every day except January 13 was below the average. The temperature was continuously below 32° on November 27, 28, December 10 to 19, 22, 23, 25, 28 to 30, January 2, 6 to 8, 10, 11, 17 to 19. The greatest defects from the average of 20 years were on November 28 (– 19°·1), December 22 (– 20°·7), and January 10 (– 19°·3). The lowest temperatures recorded during the three months were 18°·3 on November 28, 13°·4 on December 22, and 12°·0 on January 10. The mean temperature of December 1890 was 29°·8, or 10°·0 below the average of the preceding 49 years, the coldest December on record since 1841 previous to 1890 being that of 1879, whose mean temperature was 32°·4. In this same month, December 1890, only 2h·4 of sunshine were recorded.

Chronometers, Time Signals, and Longitude Operations.—The number of chronometers and deck watches now being tested at the Observatory is 169 (113 box chronometers, 20 pocket chronometers, and 36 deck watches). The annual competitive trial of chronometers commences on July 4, and the trial of deck watches on October 24.

The time-balls at Greenwich, Deal, and Devonport are next referred to.

The reductions for the longitude Paris–Greenwich are now completed and ready for publication. In reference to the discrepancy between the results of the French and English observers, mentioned in the last Report, Commandant Defforges visited Greenwich in June 1890, and went carefully through the reductions with Mr. Turner and Mr. Lewis. No mistake was found in the work, but several questions of some importance were raised. The results of the discussion and of subsequent correspondence are summed up in two papers by Mr. Turner and one by Colonel Bassot and Commandant Defforges, in the *Monthly Notices of the Royal Astronomical Society*, vol. li. pp. 155, 407, and 413 respectively. As the matter now stands, the English definitive result for the difference of longitude between the Greenwich transit-circle and Cassini's meridian is 9m 20s·86, while the French result (not yet published) is about 0s·15 greater, a discordance which, though only about half of that found in the preliminary discussion, is still so large, that there seems to be no alternative but to repeat the work with special precautions suggested by the experience gained.

The proposal to determine the longitude of Montreal as the base station for the Geodetic Survey having been sanctioned by the Admiralty last December, arrangements have been made in concert with Prof. McLeod, of the McGill College Observatory, Montreal, for a determination of the longitudes Montreal–Canso–Waterville–Greenwich, the termini of the cable, Canso and Waterville, being occupied as longitude and not merely as transmitting stations, a course which seems advisable in view of the great geodetic importance of these points. The necessary funds have been voted, and the Commercial Cable Company have generously granted the use of their cable.

The determination of the longitude of Washington has been deferred for the present.

During the past year, Lieutenants Heming, Monro, and Smyth, R.N., and Captain Haynes, R.E., have at various times been instructed in transit-observing. Mr. S. Hirayama, of the Tokio Observatory, was at work for some weeks studying the general organization of the Observatory.

THE CLASSIFICATION OF THE TUNICATA IN RELATION TO EVOLUTION.

THE detailed classification of the Tunicata, and especially of the so-called "Compound Ascidians," has usually been found a matter of special difficulty by systematists, and each successive investigator has discovered grounds for modifying in important respects the grouping of genera and families established by his predecessors. A glance at the systems of Giard, Della Valle, von Drasche, and Lahille, all of recent date (*i.e.* post-Darwinian, and since the introduction of modern methods and the recognition of the Tunicata as Chordata), shows the notable want of agreement between competent authorities. There is probably a special reason for this exceptional diversity of opinion, and I believe the cause is to be found in the course of evolution or phylogeny of the group, and especially in the complex relations between the Compound forms and the other Tunicata.

In fact, if the matter be regarded from the point of view of the consistent evolutionist, the special difficulties vanish, the complicated relationships between groups (which can only be represented by dendritic diagrams, or even in some cases by networks) become explicable and natural, the great diversity in value of the assemblages of forms known as "genera" and "species" is simply what would be expected, and the differences between the various classificatory systems (allowing for a few errors which have been corrected by later investigations) can be accounted for, and the conflicting opinions of the authors reconciled. But, on the other hand, if the subject be approached from the standpoint of the pure systematist, whose object is to divide and subdivide into clearly defined groups of approximately equal value, and to recognize only "good" genera and species, nothing but confusion results; it becomes practically impossible to distinguish and arrange naturally the groups of Simple and Compound Ascidians; and some of the most interesting and instructive points, such as the gradation of varieties into species and species into genera, and the individual variations in specific characters, are altogether lost sight of.

These views were expressed partly in my Reports

on the *Challenger* Tunicata, but further work since—on some very extensive collections from Australian seas and on the Ascidians of our own coasts—has convinced me that the only rational explanation of the protean forms and labyrinthine inter-relations of the Ascidians is to be found in regarding the group as one in process of evolution, where many of the species, genera, &c., have not yet become markedly differentiated by the elimination of intermediate forms, and where the animals are so much at the mercy of their environment that a special premium is set upon useful characters (if, indeed, there are any "specific" characters which are not useful), and where, consequently, the relations between modification of structure and conditions of existence brought about by the action of natural selection are exceptionally evident. Adopting, then, this view, the following difficult subjects of dispute, and probably others with which I am not concerned at present, can be, I think, satisfactorily explained: (1) the connection of the Simple with the Compound Ascidians, and the classification of the latter; (2) the value of some modifications of the branchial sac; (3) the position of the Polystyelidæ; (4) the relations between the sub-families and genera of the Cynthiidæ; and (5) the numerous "species" of the genus *Botryllus*.

(1) If the attempt is made (as in most classifications) to regard the Compound Ascidians as a group distinct from the Ascidiæ Simplices, and forming either a parallel or a divergent line in regard to the latter, one meets at once with the serious difficulty that the Compound Ascidians show affinities with the Simple at several distinct points. Three investigators approaching the Compound Ascidians after the previous study of certain Simple Ascidians—say, the first fresh from *Ciona*, *Ecteinascidia*, and *Clavelina*, the second from *Perophora*, and the third from *Styela* and *Polycarpa*—could each make out a good case for the view that his new subjects were most closely connected with the genera he had just been working at. The first could demonstrate the undoubted relations, in external form and in structure of branchial sac, between *Clavelina* and *Chondrostachys*, *Colella* and the other Distomidæ; the second might point to the similarity (on which I personally lay no stress) of *Perophora* and the Botryllidæ, in the relations of alimentary canal to branchial sac; and the third could show the close similarity between the Styelinæ and the Compound forms *Synstyela*, *Goodsiria*, and *Chorizocormus* in nearly every detail of internal structure: and all three would be partly right, and therefore unlikely to agree upon any one system of classification.

But when the attempt is made seriously to form a conception of the past history or evolution of the forms in question, it becomes obvious that the Compound Ascidians are not a natural, but an artificial group. That is, they are not the whole surviving descendants of a single group of ancestors, but are polyphyletic in origin, being derived from several distinct lines of ancestry which have arisen independently from different kinds of Simple Ascidians, and have since acquired the common characteristic of being able to reproduce by gemmation so as to form compact colonies in which the members (ascidiozooids) are embedded in a common test or investing mass. We know with as much certainty as we know anything in such phylogenetic inquiries that the ancestral Tunicates were not colonies, and that reproduction by gemmation was not a primitive character. This property has, then, been acquired secondarily by some ancestral Simple Ascidians, and may very possibly have been acquired more than once (though this is not at all necessary for my theory of the polyphyletic origin). It follows from this view (which I have expressed before, but now feel more certain of from recent work), that if we are to retain the group Ascidiæ Compositæ, or Synascidiæ, in our system, we must represent it as linked on to the Ascidiæ Simplices, at three points at least, and we must not attempt to arrange the families and genera in a series diverging from any one of these points alone; or if we do, we need not be surprised when we arrive at obviously unnatural arrangements which are in conflict with the classifications of our fellow-workers.

On the other hand, we might abolish the group Ascidiæ Compositæ altogether as a sub-order of Ascidiaceæ, on the ground that it is not a natural group (*i.e.* a compact set of descendants from a common ancestor—a single branch of the genealogical tree).

But if we adopt this course with the Compound Ascidians, the same argument might be used in connection with other polyphyletic groups throughout the animal kingdom. They should all be broken up, it might be urged, as being artificial assemblages. And that would be a perfectly logical and definite position to take up, and one for which a good deal could be said, but before adopting it zoologists should remember that it involves a loss as well as a gain. If it gives "the system" a certain precision, and an advance of a step or two towards the goal of a completely natural classification, it at the same time destroys the recognition of characteristics which certain forms possess in common. In whatever manner they have been obtained, there is no doubt that Compound Ascidians of the present day possess certain features by which they can be identified as Compound Ascidians, and this fact is surely worthy of recognition in our "system." My own opinion, then, is that the group Ascidiæ Compositæ should still be retained, but that its polyphyletic origin and multiple connection with the Ascidiæ Simplices should be carefully borne in mind when drawing up any scheme of classification, or discussing affinities.

(2) Some of the ideas noted above, and others to be discussed below, took definite form lately in reading a recently published memoir by M. Fernand Lahille,[1] in which, while giving a number of important original observations on the anatomy and bionomics of the Ascidians (and especially of the Compound forms) of the French coasts, the author introduces what I cannot help thinking in some respects an unfortunate attempt to remodel the classification of the Tunicata on lines which he communicated a few years ago to the French Association (Congrès de Toulouse, 1887), and now elaborates in detail. He regards the branchial sac as the most important organ in the Tunicata, and so it is in some respects; but that is not sufficient reason for regarding its modifications in structure as the sole characteristics of the primary groups. For example, the Appendicularians, instead of being called Larvacea or Copelata, and characterized by the presence of a tail containing the urochord, are placed in a group "Atremata," defined by the absence of stigmata in the branchial sac. The openings in question (stigmata) are not even such important structures as the primary branchial clefts (gill-slits), but are merely the secondary slits placing the cavity of the branchial sac in communication with the peribranchial or atrial cavity, and are of nothing like such high morphological value as the presence or absence of a urochord, and of the two primitive atriopores, and the other well-known characteristics employed in former classifications as distinguishing the Appendiculariidæ. Some of the Thaliacea are placed by Lahille in a group (Hemitremata) of primary importance, by themselves, because they have the stigmata rudimentary or imperfectly formed, while the other Thaliacea are united with all the remaining Tunicata, because they are supposed to be alike in having complete stigmata.[2]

Then, again, an altogether fictitious value is given by Lahille to the presence of internal longitudinal bars in the branchial sac, especially since he shows (as had been done by former writers) that these bars develop as outgrowths

[1] "Recherches sur les Tuniciers des Côtes de France" (Toulouse, 1890).

[2] Which, however, is not really the case. The apertures in the walls of the branchial sac in Lahille's "Eutremata" are not always homologous structures. In the genus *Culeolus*, for example, there are no true stigmata.

from the connecting ducts, and that intermediate conditions can be found in which the bars can neither be said to be absent nor present. He describes this condition in his new species *Perophora banyulensis*, and it is also present in *P. viridis*, Verrill, and in various other Simple Ascidians, as has been shown in the *Challenger* Reports and elsewhere.

Such cases, although rather perplexing to the systematist, are perfectly natural from an evolutionist's point of view, and they certainly make one regard with some suspicion large groups founded upon any such one character. Consequently, Lahille's order "Stolidobranchiata," characterized solely by the presence of a particular kind of internal longitudinal bar in the branchial sac, is, in my opinion, a most unnatural assemblage of the families Polystyelidæ, Cynthiidæ, Molgulidæ, and Botryllidæ, which cannot be retained. It is not safe to trust to the modifications of structure of one organ in the detailed classification of a group, and it is especially unsafe where that organ is, as in the case of the branchial sac, of great physiological importance, and so is liable to be considerably modified in accordance with the mode of life in forms which are otherwise closely related. Morphological characters of less functional importance are more likely to be retained unaltered, and so indicate real genetic affinity.

Surely Lahille does not seriously mean to contend that the internal longitudinal bars in the branchial sac of the Botryllidæ, Cynthiidæ, &c., are different in any morphological sense from the similar bars found in other Ascidians, such as the Ascidiidæ. Although they may be slightly different[1] in their relations to the wall of the sac in these two groups, being attached throughout their length in *Botryllus* in place of only at the angles of the meshes as in *Ascidia*, and are therefore somewhat different in their development (ontogeny), there can scarcely be any doubt that in their origin (phylogeny) all such bars in the branchial sac are alike, and are therefore homologous structures.

(3) It follows from what has been said above in regard to the origin of the Compound Ascidians, that even though the group Polystyelidæ is placed (as was the case in the *Challenger* Report) in the Ascidiæ Compositæ, it is not thereby widely separated from its relations amongst the Simple Ascidians. If the sub-order Ascidiæ Compositæ is retained, then the Polystyelidæ must go in it, since they form definite permanent colonies with the ascidiozooids embedded in a common test; but of course these forms are very similar in many respects to *Styela* and *Polycarpa*—that being one of the points of contact between Compound and Simple Ascidians—and therefore I can agree fully with all that Lacaze-Duthiers and Delage say in favour of that relationship. The matter stands simply thus:—If Ascidiæ Compositæ is retained, the Polystyelidæ must be placed in it at the nearest point to *Polycarpa* amongst Ascidiæ Simplices; while if Ascidiæ Compositæ is abolished, the Polystyelidæ will form a family or a sub-family (it matters little which) alongside the Styelinæ under Ascidiæ Simplices. To go further, and break up even the genera of the Polystyelidæ, placing the species beside those Cynthiidæ they resemble most in the structure of the branchial sac, would be to give no value at all to the property of reproduction by gemmation and the formation of colonies.

(4) It has long been recognized that there are two groups of forms in the family Cynthiidæ, those which centre around *Styela* and those related to *Cynthia*, and when the remarkable stalked forms, such as *Boltenia* and the deep-sea genus *Culeolus*, had been added, I defined these three groups as sub-families under the names Styelinæ, Cynthinæ, and Bolteninæ. Leaving the last out of the question, we have the two former distinguished amongst other characters by the fact that the Styelinæ have never more than eight folds in the branchial sac, and have simple tentacles, while the Cynthinæ have always more than eight folds, and compound tentacles.

A few years ago these seemed well-established characters to which there were no exceptions. Last year, however, Lacaze-Duthiers and Delage published a preliminary account of a *Cynthia* from the French coasts, with only eight folds (as in Styelinæ) in its branchial sac; while Traustedt has discovered that the *Cynthia tesselata* of Forbes has four folds on the right side of the branchial sac and three on the left (like some Styelinæ), although the tentacles are compound (as in Cynthinæ); and I find that long ago Alder described the reverse case in *Cynthia tuberosa*, Macg., where there are twelve folds in the branchial sac (Cynthinæ), although the tentacles are simple (Styelinæ). Thus the two links required to unite the characters[1] of Styelinæ and Cynthinæ have been found, which is perfectly natural and satisfactory to the evolutionist, and the question for the systematist now is, Must these two sub-families be united? I think not. I believe that they are natural groups, and that they are really as widely separated from one another in their typical members as we ever supposed them to be, although not so completely isolated from one another by the extinction of intermediate forms.

If these interesting links, to which attention has just been drawn, and which are apparently not common nor widely distributed forms, had become extinct a few years ago, the Styelinæ and Cynthinæ would without question be justly regarded as widely separated groups. And the present position is merely that a few forms are known which if not bridging over at least lie as stepping-stones in the gap; while the vast majority of the species in question are clearly distinguishable by easily recognized characters into two definite sets. This last fact has an importance which entitles it to recognition. I am far from wishing to ignore the importance of such intermediate forms; in fact I am more likely, I fancy, to regard them with undue interest; but after all they are single species, minute twigs of the great branch under consideration, while long series of typical Styelinæ and Cynthinæ—the many species of *Styela* and of *Polycarpa*, of *Cynthia* and of *Microcosmus*—can be divided into two groups by their tentacles and their branchial folds, and I believe we are justified in giving expression to this natural grouping by retaining the two sub-families in our system of classification. It need not lead to any difficulties: the intermediate forms can be placed as an appendage to the sub-family taken first. We cannot now pretend to draw hard and fast lines round all our groups, a serial or a tabular classification will always give erroneous impressions, and in a phylogenetic arrangement the linking forms will appear in their proper places as little twigs between the two great branches.

(5) The genus *Botryllus* seems to contain an endless series of forms which might be (and many of which have been) described as separate species. Giard, twenty years ago, pointed out the great variability of the species in this genus, and described many varieties and local conditions, but the supply is not yet exhausted, and one is almost tempted to conclude that no satisfactory position can be taken up anywhere between the two extremes of either (1) regarding the whole genus (or even the family Botryllidæ) as an enormous protean species, or (2) describing nearly every colony as a separate species.

From the point of view of the systematist or speciographer who wants "good" and well-defined species, this group of Ascidians must be an abomination, but to the student of evolution it is full of interest. Here, if anywhere, characters can be seen varying in all

[1] Even this difference is not constant. In some Botryllidæ, and I think in all Polystyelidæ and many Cynthiidæ, the relations of the bars in the adult are precisely as in *Ascidia*, *Ciona*, and *Ecteinascidia*.

[1] These are the chief characters, but there are others, such as the condition of the stomach and digestive glands.

directions and to almost all degrees, some variations becoming fixed while others remain indefinite. I am at present examining (with the help of my former student, Miss A. E. Warham, B.Sc.) the anatomical characters of a number of colonies of various *Botrylli* with the view of finding which characters, if any, can be relied on in distinguishing species or "forms," and I have just seen a series of ascidiozooids of *Botryllus smaragdus* in which the branchial tentacles, usually regarded as important features in the diagnosis of species, present all variations between eight and sixteen. Every one of the numbers 8, 9, 10, 11, 12, 13, 14, 15, and 16, is represented by one or more ascidiozooids, although 8 and 16 are those most commonly found. Also several definite arrangements, such as 2 large pigmented tentacles and 6 small, 3 large pigmented and 13 small, are present, and are connected by all possible gradations. Then, again, we find that the smaller set of these tentacles may be all alike, or may be of two sizes placed longer and shorter alternately, or they may be 2 shorter and 4 longer, or 2 shorter and 5 longer, or 3 shorter and 5 longer, or 4 shorter and 5 longer, or 6 shorter and 5 longer, and so on through the variations. Two or three of the extreme forms, if examined by themselves, might easily be regarded as distinct species.

I have heard it said, and I fancy it may be often thought, that since evolution has changed our conception of a species, the modern biologist need not concern himself with the description and nomenclature and delimitation of those assemblages of variable forms which are known as varieties and species. But to take such a course would be a great mistake. The theory of evolution has given taxonomy and speciography an additional and a very real interest. Now that we know just how much and how little the term species indicates, it has become of great importance that species and varieties should be re-studied from the evolutionary standpoint, that the relations of allied forms should be carefully investigated, the limits of their variation determined, and the effect of their environment ascertained. The Botryllidæ form a specially interesting group for such an investigation.

Many of these more general remarks will no doubt apply to other groups of organisms with as much force as to the Tunicata, but some of the instances discussed above may seem points of mere detail of no great general interest. I believe, however, that they are typical cases illustrating difficulties which may confront any specialist in the course of his endeavour to attain to that important object of biological investigation—a natural or genetic classification of animals and plants.

February. W. A. HERDMAN.

PHOTO-STELLAR SPECTRA.[1]

PROF. PICKERING, while retaining the four types of stellar spectra, finds that so many stars show an intermediate stage of development, that, in the Draper Catalogue, letters are substituted for the types. Thus, letters A to D denote stars of the first type; E to L, stars of the second type; M, stars of Type III.; while N is reserved for fourth type stars. It seemed of some interest to compare the photographic results with those obtained directly with the spectroscope. For the first and second types, the observations of Vogel ("Spect. Beob.," – 1° to + 20°) were used. The stars in the first four hours of R.A. which occur in both works were examined and tabulated, those being rejected where there was any uncertainty as to type in Vogel's observations. The following table shows the results thus obtained:—

[1] "Note on the Classification of Star Spectra in vol xxvii. *Harvard Annals*, and on some Stars with Bright Lines."

Vogel. Eye observation. Class.	Pickering. Photographic observation. Letter.						
	A	B	E	F	H	I	K
I.	68	1	25	18	15	1	1
I. !	35	1	4	—	—	—	—
II.	4	—	5	—	28	—	1
II. !	—	—	—	—	—	—	—
II. !!	—	—	—	—	2	—	2

To show the differences in type, the following table has been drawn up:—

Vogel. Stars. Number and Type.	Pickering. Type I.	Type II.
169 of I. ...	105	64
42 of II. ...	4	38

These tables show that, in the case of Type I., nearly half the stars observed with the eye are really Type II. according to the photographs; in the case of Type I. !, four out of the forty, although having a clearly pronounced first type spectrum to the eye, are really second type stars according to the photographs. In the case of the second type, four stars out of forty-two are really first type.

For the third type stars, Dunér ("Sur les Étoiles," &c.) was consulted, and the following results were obtained:—

Dunér. Eye observation. Type.	Pickering. Photographic observation. Letter.						
	A	E	F	H	I	K	M
III.	—	—	—	19	2	—	8
III. !	—	—	—	24	2	1	22
III. !!	3	—	—	16	1	1	24
III. !!!	—	1	1	5	—	—	12

This table may be condensed as follows:—

Dunér. Type.	Pickering. Type.			
	I.	II.	III.	Total.
III. to III. ! ...	—	48	30	78
III. !! to III. !!! ...	3	23	12	38
Total ...	3	71	42	116

The photographs therefore show that only 36 per cent. are third type at all. In order to account for this very remarkable result, the words of Prof. Pickering may be quoted:—"The difference between this (the third) type and the second is much less marked in the photographic than in the visible portion of the spectrum. The most noticeable difference is that, in spectra of the third type, the intensity suddenly changes at the wave-length 476·2. Rays of greater wave-length than this are fainter than those that are shorter."

It will be seen that three stars of the third type appear as first type stars on the photograph. These are:—

(1) LL. 3717, 1h. 55m. – 9° 0′·4, Dunér III. !!: "Les bandes 2–9 sont fortement développées, très larges et sombres."

(2) D.M. + 17°·1479, 6h. 56m. + 17° 53′·8, Dunér III. !!: "Les bandes 2–8, et peut-être 9, sont visibles; elles sont très larges et fort obscures autant dans le vert-bleu que dans le rouge."

(3) τ^4 Serpentis, 15h. 31m. + 15° 25′·9, Dunér III. !!: "Les bandes sont larges et fortes, surtout dans le vert et dans le bleu."

Prof. Pickering states, in the preface, that when the brightness exceeds 6·5 it is difficult to classify the spectrum with certainty. The photographic magnitudes of these stars are 6·65, 6·45, 6·44 respectively.

As regards the fourth type, it is stated (p. 3) that "the letter N is reserved for spectra of the fourth type, although no star of this type is bright enough to appear in the Draper Catalogue, owing to the red colour of all such

stars." This seems to be a mistake, as three fourth type stars are found in the Draper Catalogue. They are:—

Name.	R.A. h. m.	Decl. ° ′	Pickering's letter.	Photo. mag.	Dunér.
D.M. +17°1973	8 49	+17 36	H	6·65	IV. !!!
D.M. +68°617	10 38	+67 56	A?	6·50	IV. !!!
D.M. +76°734	19 25	+76 22	E	7·08	IV. !!!

These stars each occur on one plate only.

The photographs show that the following stars have bright lines in their spectra:—

Known variable stars: ϵ Aurigæ, α Orionis, ζ Geminorum, α Herculis, β Pegasi.

Suspected variable stars: α Cassiopeiæ, 66 Ceti, ρ Persei, α Tauri, δ Canis, β Geminorum, α Boötis, β Ursæ Minoris, β Cygni, γ Cephei.

Other stars showing bright lines, not hitherto detected, are: τ Ceti, γ Andromedæ, κ Persei, α Persei, ν Persei, 80 Tauri, ζ Aurigæ, ζ Cancri, σ^1 Ursæ Majoris, o Leonis, γ Leonis, ξ Ursæ Majoris, 43 Comæ, o Boötis, γ Scorpii, β Coronæ, ζ Herculis, η Herculis, μ Herculis.

T. E. ESPIN.

SOME ASPECTS OF STAS'S WORK.

FOR the last thirty years Stas's work has set the standard of excellence in all that relates to atomic weight determination. The literature of the subject teems with references to his classic memoirs, which have come to be regarded by chemists in the light of canonical books. Admiration of the almost magical accuracy of Stas's results seems somewhat to have diverted attention from the rare philosophical insight displayed in the *plan* of his researches. Yet it is not too much to say that, while we owe the *conception* of the atomic theory to Dalton, Stas first placed the theory on a sound experimental basis.

It was in the year 1843 that Dumas and Stas's value for the atomic weight of carbon recalled attention to the hypothesis of Prout which had hitherto met with little favour on the Continent. The subsequent work of Dumas and of de Marignac led these chemists to support the hypothesis in a modified form. In 1860 appeared the first series of Stas's researches, "Sur les Rapport reciproques des Poids atomiques." In the introduction to his paper the author stated his conviction that these researches furnished proof, as complete as the nature of the subject admitted, that the hypothesis of Prout was a pure delusion —that there was, in fact, no common divisor between the atomic weights of the elements. In reviewing the work of Stas, de Marignac admitted the impossibility of reconciling the concordant results obtained by Stas and himself with even the modified form of Prout's hypothesis. Yet he regarded the dictum quoted above as too absolute in character. It was by no means established, he contended, that the constituents even of stable compounds are present *exactly* in the proportion of the atomic weights. De Marignac's criticism struck at the very basis of the atomic theory but this by no means deprived it of its weight. The laws of chemical combination are the experimental basis of the atomic theory, and Stas admitted that these laws had never been proved as "lois mathématiques." Writing in 1865, in the introduction to his "Nouvelles Recherches," he remarks that some of the fundamental ideas of chemistry, which are generally taken as having been proved, are as a matter of fact far from being so. He considers that the constancy of composition of chemical compounds has been experimentally established, but points out that this does not constitute a proof of the law of constant proportions, the law, viz., which states that the particular proportions in which two elements are combined in a certain compound is a *constant* proportion in all the compounds which contain those elements. This had never been proved, yet it was only in this way that the position of the atomic weights as constants of nature could be established. The so-called *law* of multiple proportions Stas referred to as an *hypothesis* of Dalton, pointing out that the very rough analyses on which Dalton relied—of which the error is frequently more than 10 per cent. —as well as the results obtained by Wollaston and by Gay-Lussac, were at most capable of establishing a "loi limité." The state of science at the time demanded a thorough re-examination of the basis of the atomic theory. Stas realized this need, and took upon himself the burden of the task. The conception and plan of the "Nouvelles Recherches sur les Lois des Proportions Chimiques" show the mind of a great thinker not less clearly than the results of the work exhibit the skill of a master in the art of experiment. The "Nouvelles Recherches" contains a verification as "loi mathématique" of the law of conservation of mass, in the complete synthesis of silver iodide, and the complete analysis of silver iodate. The constancy of composition of chemical compounds was subjected to a crucial test in the experiments on ammonium chloride, and the constant proportion between the combining weights of elements in different compounds was tested in the conversion of silver iodate, bromate, and chlorate, to the corresponding haloid salts. The law of equivalent proportions was verified by the concordant results obtained for the atomic weights of silver and of the alkali metals determined as functions of those of iodine, of bromine, and of chlorine respectively, oxygen forming the common standard. One cannot help regretting that the law of multiple proportions was not also made the subject of investigation. The most suitable examples occur among gaseous substances, and the operations of gas analysis were foreign to the methods of manipulation employed by Stas. The complete analysis of nitrous oxide was indeed contemplated in order to determine directly the atomic weight of nitrogen as a function of that of oxygen, but the idea was abandoned owing to the difficulty of constructing the necessary apparatus.

The work on the laws of combination furnished fresh materials for the examination of Prout's hypothesis. Stas's comments on the origin of this hypothesis possess a high degree of philosophic interest. The remarks to which we more particularly refer are the following:—"Lorsqu'on remonte à l'origine de l'hypothèse (de Prout) on s'aperçoit immédiatement qu'elle doit sa source à un préjugé ou, si l'on veut, à un opinion préconçue, concernant la simplicité des lois de la nature. Pendant longtemps les chimistes comme les physiciens, dès l'instant qu'ils ont vu certains faits se reproduire avec une *apparence* de régularité, ont cru à l'existence d'une loi naturelle susceptible d'être exprimée par une relation mathématique *simple*. . . . . C'est à cette tendance, d'ailleurs très-naturelle, qu'on doit l'hypothèse de Prout." Dalton's enunciation of the law of multiple proportions is relegated by Stas to the same category as a generalization on insufficient data. Mendeleeff has remarked (Faraday Lecture, 1889) that the periodic law has shown that the masses of the atoms increase *per saltum*, in a manner which "is clearly connected in some way with Dalton's law of multiple proportions." Dalton was more fortunate than Prout. The combining proportions are expressible by a simple mathematical law, whilst the atomic weights are only to be represented by a complicated formula which may have some such form as that proposed by Carnelley.

The "Nouvelles Recherches" appeared in 1865. The first paper on the periodic system was read before the Russian Chemical Society in the spring of 1869. It is curious to reflect that the foundations of the atomic theory had hardly been made sure by Stas ere they were called upon to bear the magnificent structure raised by Mendeleeff.

V. C.

NOTES.

WE print elsewhere the proceedings of the important deputation to the Board of Trade on the subject of the Institute of Preventive Medicine. There can be no doubt that, after the statement made by the Minister, the registration of the Society will shortly be an accomplished fact; a few words in the deed of registration or a few minutes of reference between the Board of Trade and the Home Office are all that is needed to safeguard Sir Michael Hicks-Beach's official scruples. The importance of the deputation, however, will not be limited to this: it shows again, as in the case of the Art Gallery, that men of science are no longer willing to be snubbed by men in office.

THE annual meeting for the election of Fellows was held at the Royal Society's rooms, in Burlington House, on Thursday last, when the following gentlemen were elected into the Society:—William Anderson; Prof. Frederick Orpen Bower; Sir John Conroy, Bart.; Prof. Daniel John Cunningham; Dr. George Mercer Dawson; Edwin Bailey Elliott; Prof. Percy Faraday Frankland; Percy C. Gilchrist; Dr. William Dobinson Halliburton; Oliver Heaviside; John Edward Marr; Ludwig Mond; William Napier Shaw; Prof. Silvanus Phillips Thompson; Captain Thomas Henry Tizard, R.N.

MR. GEORGE HOLT, of Liverpool, last week sent the Treasurer of the University College there a cheque for ten thousand pounds as endowment for a Chair of Physiology, and candidates for the appointment are forthwith to be advertised for. It is only a few weeks since Mr. Brunner, M.P., sent a similar cheque to endow a Chair of Political Economy. The latter post has been offered to and accepted by Mr. E. C. K. Gonner.

THE Prince of Wales has fixed 4 o'clock on Wednesday, June 17, for the delivery by Lord Rayleigh of the first of the two lectures at the Royal Institution in connection with the centenary of the birth of Michael Faraday; and Friday evening, June 26, at 9 o'clock, has been appointed for the second of these lectures, which will be given by Prof. Dewar.

STUDENTS of geology were sorry to hear of the death of Dr. P. M. Duncan, F.R.S. He died on May 29 in his sixty-seventh year. Dr. Duncan was Professor of Geology at King's College, London, and was intimately connected with the Geological Society, of which he was President in 1876 and 1877. He was also a member of the Linnean Society.

MR. G. V. POORE, the Government Inspector, who has recently drawn up a report upon experiments performed on living animals during the year 1890, states that during the many visits he has paid to places licensed for the performance of such experiments, it has never fallen to his lot to see a single animal which appeared to be in bodily pain.

WE are glad to be able to announce that Mr. J. Graham-Kerr, of the University of Edinburgh, Naturalist to the Pilcomayo Expedition, has returned safely to this country, and has succeeded in bringing with him a portion of his natural history collections. As is well known, the *Bolivia*, in which Captain Page and his expedition ascended the Pilcomayo, was stranded in that river, in April 1890, in the middle of the Gran Chaco. After the death of Captain Page, which occurred while he was returning in a canoe down the Pilcomayo to get medical assistance, the *Bolivia* remained stuck fast nearly in one spot until March of this year, when Mr. Kerr, finding the vessel still immovable, and no prospects whatever of a rise in the river, decided to come away as best he could. After a very rough journey he reached Asuncion on mule-back, bringing as many of his light things as possible, and arrived in this country last week. Some very interesting letters of Mr. Kerr's, describing the natural history of the Gran Chaco, will be found in the two numbers of the *Ibis* for January and April last.

UNDER the will of Dr. Fothergill (1821), funds were bequeathed to the Society of Arts for the offer of medals for subjects, in the first instance, relating to the prevention of fire. A Society's Gold Medal, or £20, is now offered for the best invention having for its object the prevention or extinction of fires in theatres or other places of public amusement.

MESSRS. NEWTON AND CO. have been appointed philosophical instrument makers to the Royal Institution of Great Britain, an appointment which we believe has not been held by any firm for some years.

MR. JOHN T. BRUNNER, M.P., has been elected President of the Sunday Society in succession to Prof. G. J. Romanes. Mr. Brunner will deliver his presidential address at the Society's public annual meeting on June 27.

THE Société Botanique de France recently held its annual meeting in the little town of Collioure, near Perpignan, on the Mediterranean coast. After the meeting many excursions were made in the neighbourhood, which is interesting to botanists.

ON behalf of Prof. E. C. Stirling, of the University of Adelaide, South Australia, Prof. Newton communicated to the Zoological Society of London, at its meeting last week, a figure of the new Australian Marsupial, originally described by Dr. Stirling in this journal in 1888 (NATURE, vol. xxxviii. p. 588), together with some notes on this extraordinary animal. *Notoryctes typhlops*, as Dr. Stirling now proposes to call it, is a small mole-like animal belonging to the order of Marsupials, of which it forms an entirely new type. A general description of it has already been given, as above referred to, but Prof. Stirling now adds that the Marsupial bones are exceedingly small nodules, and escaped his notice at first. Four or five of the cervical vertebræ are fused, and there is a keeled sternum, an enormously thick and short first rib, which serves a purpose of buttressing the sternum in lieu of coracoids, and a bird-like pelvis. The penis is in the uro-genital canal, and the testes are external in front of it. The eyes are mere spots underneath the skin. The four specimens as yet received of *Notoryctes typhlops* were obtained in the centre of Australia, on the telegraph line between Adelaide and Port Darwin. The animal is said to burrow in the sand with great rapidity. A full description of it, it is understood, has appeared in the Transactions of the Royal Society of South Australia, but no copy of this journal has as yet reached England.

MM. GRÉHANT and Quinquaud conclude from some recent experiments on dogs that under the influence of alcohol muscular strength is much diminished.

PROF. JOHN M. COULTER, the well-known botanist, has been elected President of the State University of Indiana, located at Bloomington; and Dr. Douglas H. Campbell has been appointed Associate Professor of Botany at the new Stanford University of California.

ACCORDING to the *Botanical Gazette*, Mr. Thomas Meehan, of Philadelphia, is about to establish, in conjunction with his sons, a new journal of gardening and botanical miscellany. It will be called *Meehan's Monthly*, and the first number will appear on July 1.

WE learn from the *Journal of Botany* that Mr. Worthington G. Smith is preparing for the public gallery of the Botanical Department of the British Museum a series of 96 tables illustrating the British Fungi. Every species of the Hymenomycetes will be figured in its natural colours, the drawings being taken from Mr. Smith's own series already in the Museum, with others from original figures lent by Mr. Plowright and others.

THE number of *Neptunia* for April 30 gives a brief description of the following stations for the study of natural history:—

A marine zoological station has been founded at Endoume, near Marseilles, by Prof. Marion, especially for the study of the fishes of the Mediterranean. M. Alphonse Biosson is about to establish at his own expense a zoological station at Point-de-Grave, Gironde, with the especial object of promoting the investigation of the ornithology and entomology of the district. A marine station for physiology has been opened at Tamaris, near Toulon, under the direction of Dr. R. Dubois, Professor of Physiology in the Faculty of Sciences at Lyons.

THE Berlin Academy of Sciences has recently made the following grants:—£100 to Dr. Fleischmann, of Erlangen, for researches in development; £30 towards the cost of publication of Dr. Krabbe's work, "Development-History and Morphology of the polymorphous Lichen Genus *Cladonia*"; £60 to Dr. Hartwig, of Bamberg Observatory, towards a series of observations on variation of the earth's axis; and £40 to Dr. Schmidt, of Halle, for researches on the light reflected from transparent bodies.

THE following are subjects for prize competition, recently proposed by the Belgian Academy of Sciences:—Advancement of our knowledge of the relation of phenomena of solution to phenomena of combinations; discussion, on the basis of new experiments, of works relating to the kinetic theory of gases; perfection of the theory of approximative integration, both as regards rigour of methods and facility of application; researches on the embryonal development of a mammal belonging to an order the embryogeny of which has not yet been investigated; determination, by means of palæontology and stratigraphy, of the relations between formations referred by Dumont to his Laekenian and Tongrian marine systems; new researches on the formation of polar bodies of animals. The prizes are gold medals, of the value of 1000, 800, and 600 francs. Papers to be written in French, Flemish, or Latin, and sent to the Secretary before August 1, 1892.

MESSRS. RICHARD FRÈRES have issued an illustrated catalogue of measuring, controlling, and self-registering instruments for scientific and industrial purposes. A descriptive and illustrated list of instruments has also been published by the Cambridge Scientific Instrument Company.

THE series of lectures annually given in the gardens of the Royal Botanic Society of London upon subjects connected with botany came to an end on Friday last, when Prof. Stewart, F.R.S., President of the Linnean Society, addressed a large number of visitors and students upon "The Relationship between Plants and Animals." The subject, he said, was one of much interest, as affording an explanation of the origin of many abnormal forms of vegetable growth. This is specially the case in tropical countries, where the struggle for existence is more intense than in colder climes; there the relationship is almost vital, some plants providing food, others shelter, to various kinds of ants, while these pugnacious insects, in turn, protect the plant from damage, by attacking any living thing which approaches it. One plant, known as the bull's-horn acacia, of Central America, provides a species of ant not only with food and drink, in the shape of tiny egg-like bodies upon the leaves—of which the ants are very fond—and a sweet fluid in special cavities on the stalk, but, in addition, furnishes a home in the hollow spines with which it is armed, these, when punctured by the ants, swelling out into perfect miniature bull's horns. In return the ants protect it from its enemies.

A SERIES of experiments with regard to evaporation from free water surfaces and from earth saturated with water, in sun and in shade, has been recently made by Signor Battelli (*Il Nuovo Cimento*). He used three large tubs or vats, two holding water, and the third earth on a grating, to which water was admitted from a pipe entering the bottom. One water-tub and the earth-tub stood a few yards apart on the north side of a high wall; the other water-tub was in the open, and embedded in the ground. Signor Battelli's results are these:—The quantity of water evaporated from moist earth is in general greater than that from a free stagnant water surface, when the air temperature rises; but less, when the latter falls. With increasing wind-velocity, evaporation increases more rapidly from the water surface. The moister the air, the greater (other things equal) seems to be the ratio of the water evaporated from the moist earth to that from the stagnant water surface. The evaporation of a water surface exposed to the sun's rays is greater than that of a shaded one, not only by day, but in the following night. With rising temperature, the ratio between the water quantities from these two surfaces increases somewhat more quickly; with rising wind-velocity, this ratio diminishes.

THE *Photographic Journal* of May 22 prints a paper by M. Léon Vidal, on photographic methods of obtaining polychromatic impressions. One of the writer's objects is to show that typographic and lithographic printers ought to find in photography "one of their principal auxiliaries." By its aid, he says, their work might be executed "more cheaply, more thoroughly, and more artistically."

ON Sunday, June 7, there was a series of severe earthquake shocks in Italy. The centre of the seismic movement seems to have been in the province of Verona, but the disturbance was felt over a wide area. At Verona three strong shocks, preceded by a subterranean noise like the roaring of artillery, are reported to have occurred at 2 o'clock a.m. The inhabitants rushed in terror from their houses to seek safety in the open streets and squares. One of the assistant mistresses at a boarding-school died of fright. A number of chimneys were thrown down by the oscillation. Still more violent were the effects of the seismic disturbance at other places in the province of Verona, especially at Tregnago and Badia-Calavena. Shocks more or less severe were experienced at Brescia, Belluno, Ravenna, Parma, Modena, and Ferrara. The Central Meteorological Bureau reports that the earthquake was very strongly felt at Florence, where it awoke several people from their sleep. The disturbance also extended to Rome, as was shown by the seismograph, the time at which the shock was felt in Rome being 6 minutes and 40 seconds after 2 a.m. In Verona and the surrounding districts slight shocks continued to be felt on Monday and Tuesday. A large stream of lava issued on Monday from the new crater of Mount Vesuvius at the base of the central cone. Signor Palmieri, the Director of the Vesuvian Observatory, holds that this flow is directly connected with the earthquake shocks in the north, and points out that seismic disturbances in Italy generally stop when the eruption of Vesuvius begins.

IN the Report of the Meteorological Service of the Dominion of Canada for the year ending December 31, 1887, just issued, it is stated that nearly eleven hundred warnings of approaching storms were issued by the Service during the year, and that of these warnings 972 were verified, being 88·9 per cent.

WE have the pleasure of recording the issue of the first volume of the Publications of the Vatican Observatory, containing astronomical and meteorological observations for the last nine months of 1890. This Observatory was first established by Pope Gregory XIII. for astronomical purposes, and was used for regular meteorological observations from 1800–1821. After passing through several vicissitudes, a proposal was made, about the time of the Vatican Jubilee Exhibition in 1888, to reorganize the Observatory, and the present Pope accordingly re-established it on a sound basis, and it is now furnished with the best instruments procurable, both for direct observation and continuous registration in meteorology, astronomy, mag-

netism, and earthquake phenomena. It is proposed to carry on various researches, and to issue further volumes from time to time, as soon as sufficient materials are accumulated. The Director is Padre Denza, the founder of the Italian Meteorological Society, and Superintendent of the Observatory at Moncalieri.

CONSIDERING the question of determination of the evaporating power of a climate, Dr. Ule distinguishes (*Met. Zeits.*) between the intensity and the speed of evaporation. The latter can be well determined with an instrument like Wild's evaporimeter, and Dr. Ule sets forth, in a table, the monthly data of this for Chemnitz, compared with those of absolute humidity, "saturation deficit," and relative humidity. The agreement of the last with the evaporimeter figures is much better than that of the two others; still, there is considerable discrepance, and this is not explained (the author shows) by variations in wind-intensity. On the other hand, the data of the psychrometer show a remarkable parallelism with those of the evaporimeter, and by taking wind-variations into account the agreement is increased. Thus, from psychrometer-differences and wind variations, the evaporative power of a climate may be correctly estimated where an evaporimeter is wanting. Dr. Ule offers a new formula for estimating the layer of water evaporated in a given time, and tests it with two German climates, and one Australian.

IN an interesting paper on technical education in agriculture, reprinted from the Journal of the Royal Agricultural Society, Dr. W. Fream refers incidentally to the value of mathematical studies for the agriculturist. Dr. Fream's professorial experience at agricultural colleges has convinced him that a lad who is fairly competent in mathematical studies is "a good medium to work upon." "Those interested in the welfare of any young agriculturist should take care," he says, "that in his school days the study of mathematics is not ignored. The time devoted to acquiring proficiency in arithmetic, geometry, mensuration, and the elements of algebra and trigonometry—the latter really indispensable in the case of surveying—will never be regretted."

THOSE who are interested in questions relating to physical education will find much to please them in an excellent paper, in the June number of *Physique*, on natural history in public schools, by the Rev. T. A. Preston, late President of the Marlborough College Natural History Society. Many boys are not much attracted by games, and it seems hard that in such cases any sort of compulsion should be used. Why not have various alternative ways of securing exercise, any one of which might be chosen? Mr. Preston shows with great force, and in a very interesting manner, with how much advantage the study of natural history might in some instances be substituted for cricket and football. Boys out for a field excursion take a great deal more exercise, he maintains, than is ever taken at cricket. "With those who are keen naturalists," he says, "the mere exercise taken in any one day (not in an excursion) is often such that it might almost be said to require moderating. I have no hesitation in saying that, if exercise alone is to be considered, a field naturalist will take far more than any one at games."

MR. W. R. HILLIER, of the Indian Civil Service, has written a very curious monograph on the manners and customs of the Shan States. When a Shan becomes a father it is considered highly undesirable that he should drive pigs, carry the dead, bore holes, fill in holes in the ground, or indulge in mockery. "If either sex," writes Mr. Hillier, "die without marrying, the body, before burial, is banged against a stump, which is at the time considered as representing the husband or wife,"—a ceremony which is supposed to guard against the danger of unrequited affection in the next stage of existence. Marriage is simplicity itself. A young man takes a fancy to a young lady, and if the liking is reciprocated, she straightway accompanies him to his house as his wife. Next day the young man's parents meet the parents of the young lady, and after informing them of what has taken place, beg that "they may be forgiven for the intrusion," and ask that a day be fixed for the wedding. This request being granted—and apparently a refusal is not contemplated—the young lady returns to her parents. Divorce is easy also, the man merely giving his wife a letter permitting her to remarry, and the wife merely being required to pay an unwilling husband thirty rupees for release from an uncongenial mate. As to food the Shan is not an epicure, eating everything that is eatable; and indeed it is considered quite becoming, if he only be of high rank, to devour an enemy. This privilege, however, is accorded only to Bohs, or chiefs. The Shan theory of the cosmogony is that "the earth came out of the depths by means of white ants."

SOME further explorations have lately been made on the Upper Irrawaddy. Major Hobday, of the Indian Survey Department, with an escort of fifty Goorkhas, succeeded in getting as far north as latitude 26° 15′ up the Malika, or right branch of the river. Here the local tribes began to show opposition, and the party could not without fighting their way have proceeded further. The point reached was, however, only fifty miles south of that which Colonel Woodthorpe gained a few years ago in his explorations from the far north of Assam. This small gap will probably be crossed when the next attempt is made, as by that time the wild tribes will have learned from their neighbours that British officers have only friendly intentions towards them. Finding his progress barred to the north, Major Hobday turned due eastwards, with the intention of striking the Meka, which is supposed to be the main stream of the Irrawaddy. After exploring the course of this river for some distance, he will journey back through the hills along the Yunnan border, reaching Bhamo by land. He will thus be able to map a considerable extent of country.

AN interesting synthesis of troilite, the crystallized monosulphide of iron, FeS, which is so frequently found in meteorites and yet is never found in terrestrial rocks, is described by Dr. Richard Lorenz, of Göttingen, in the current number of the *Berichte*. A stream of dry sulphuretted hydrogen gas was led over a bundle of iron wire contained in a combustion-tube heated in a furnace. As soon as the wire became heated to dull redness, it became quite changed, becoming completely covered with innumerable brilliant little crystals. These crystals possessed a bright silver-white lustre when first obtained, but after a short time reflected a pale-green coloured light. On standing for some days, the crystals further changed in colour to blue and afterwards to brown, without the least change in the form being apparent. Under the microscope they appear to consist of well-formed six-sided tables of a bright steel-gray lustre. Prof. Groth, the eminent crystallographer, who has examined them, pronounces them to be hemimorphic hexagonal in form, isomorphous with wurtzite, the hexagonal variety of zinc sulphide. Any kind of iron may be substituted for the wire; whatever the variety employed, it always becomes covered with a crust of these crystals when heated in a stream of sulphuretted hydrogen, the only precaution necessary being to prevent the temperature from rising to the melting-point of monosulphide of iron. The crystals are readily detached from the iron, and upon analysis yield numbers very near the theoretical ones required by FeS. The largest and best developed individual crystals of troilite are obtained by diluting the sulphuretted hydrogen with an inert gas. Wurtzite, sulphide of zinc, ZnS, may also be readily artificially obtained in a similar manner by passing sulphuretted

hydrogen over zinc heated to whiteness in a porcelain tube in a Schlösing furnace. When the tube, which is allowed to cool in the stream of gas, is broken, immediately beyond the portion which has been heated in the furnace a beautiful sublimate of crystals of wurtzite is found. They consist of well-developed hexagonal prisms, somewhat transparent and of a yellow colour, exhibiting, according to Prof. Groth, their hemimorphic nature in a most decided manner. In a similar way also Dr. Lorenz has artificially prepared greenockite, sulphide of cadmium, CdS. This synthesis is perhaps the easiest of all to effect, and it may readily be conducted in an ordinary combustion-tube. The metallic cadmium is placed in a porcelain boat, and commences to react with the sulphuretted hydrogen at a temperature just below its boiling-point. As soon as this temperature is attained, the porcelain boat and the portion of the tube beyond it become covered with magnificent long yellow skewer-like crystals of greenockite, which Prof. Groth finds to be of two kinds, hexagonal prisms isomorphous with troilite and wurtzite, and a new form of greenockite consisting of monoclinic crystals. Dr. Lorenz has further artificially prepared millerite, the sulphide of nickel, NiS, by the same method, obtaining in this case very minute but undoubtedly hexagonal crystals isomorphous with the three other sulphides above described.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. Walter Fraser; a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Colonel Beresford; a Great Black-headed Gull (*Larus ichthyaëtus*) from the Persian Gulf, four Macqueen's Bustards (*Houbara macqueeni* ♂ ♂ ♀ ♀) from Western Asia, three Chaplin Crows (*Corvus capellanus*) from Persia, presented by Mr. B. T. Ffinch, C.M.Z.S.; a Diamond Snake (*Morelia spilotes*) from New South Wales, presented by Mr. J. Hellberg; a Common Viper (*Vipera berus*) from Hampshire, presented by Mr. W. H. B. Pain; two Piapecs (*Ptilostomus senegalensis*) from West Africa, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), four North African Jackals (*Canis anthus*), two Partridge Bronze-wing Pigeons (*Geophaps scripta*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE SPECTRA OF DOUBLE STARS.—A note on "The Discovery of Double Stars by means of their Spectra" is contributed by Prof. E. C. Pickering to *Astronomische Nachrichten*, No. 3034. When the components of a close binary system have similar spectra, relative orbital motion in the line of sight may cause a periodic doubling of the lines. But if the spectra be not similar any lines common to both ought to be conspicuously strong, and, provided the components have not equal and opposite velocities in the line of sight, ought also to be displaced with reference to other lines. Thus, if one component of a close binary system has a Group V. spectrum, like our sun, and the other a Group IV. spectrum, in which strongly marked hydrogen lines is the main feature, the resulting spectrum will have a composite character, and careful measurements should show that the position of the hydrogen line is periodically displaced when compared with the lines characteristic of the solar-type spectrum. α Canis Majoris is the brightest star having this composite spectrum, and the wave-length of the hydrogen line G, derived from a comparison with three lines of greater and three lines of smaller wave-length, was 434·09, which exceeds that derived from the solar spectrum by 0·03. Similar measures of the hydrogen line *h* gave a wave-length of 410·22, which also exceeds that in the solar spectrum by 0·03. From this displacement it would appear that if the phenomenon is due to the relative motion of a faint component, it is receding at the rate of 20 kilometres per second, as compared with the bright component. An examination shows that the following stars have the composite spectrum referred to: γ Andromedæ, H.P. 650, ε Boötis, ε Scorpii, and β Cygni, all of which are known to be double; also π Persei, ζ Aurigæ, δ Sagittarii, 31 Cygni, and β Capricorni. In the cases of the last two, the spectra of the distant companions are distinctly separated from those of the chief stars. Although the strong hydrogen lines in the spectra investigated may be due to the presence of a faint companion, their intensity may also be due to many other causes. Thus, the strong hydrogen lines in the solar spectrum are not due to the integration of the spectrum of the sun and that of a companion. It is necessary, therefore, to determine whether the displacement is subject to a periodic variation or not, in order to test this method of discovering close binaries.

THE PERSEID RADIANT.—At the St. Petersburg Academy of Sciences, on April 22, M. Bredichin concluded, from the meteor observations made at Pulkova by ten astronomers in August 1890, "le courant des aérolithes n'est pas délimité par un point ou un petit rond, mais présente une surface considérable parsemée de radiants."

THE FLORA OF DIAMOND ISLAND.

DIAMOND ISLAND is situated at the mouth of the Bassein River, in the Indian Ocean, about five miles from Pagoda Point and eight miles from Cape Negrais, and in about 16° N. lat. It is of sandstone formation, somewhat exceeds a square mile in area, being about twice as long as broad, and the central part is a kind of plateau 60 feet or so above the level of the sea. With the exception of a small clearing for a telegraph station, the island is densely wooded down to the sea, but there is no mangrove belt on any part of the sandy coast, unless it be considered as represented by a few patches of *Avicennia officinalis*. Thus is the island described, though in greater detail, by Dr. D. Prain, Curator of the Herbarium of the Royal Botanic Garden, Calcutta, who has visited the island in H.M. Indian Marine Survey steamer *Investigator*, commanded by R. F. Hoskyn, R.N. Dr. Prain has published an elaborate analytical account of the flora in the Journal of the Asiatic Society of Bengal. He collected eighty-six species of flowering plants, three ferns, and four funguses, among which there was not a single novelty. The enumeration includes a number of cultivated plants, among them the coco-nut palm; but these are all of recent introduction. It is supposed that the island was not previously inhabited, and therefore that the vegetation of the dense wood overspreading the island is quite natural. The most interesting fact brought out is the evident affinity with the somewhat distant Andaman flora, pointing to a former connection. The Report is also valuable to the student of plant-distribution for the details it contains of the habitats and relative frequency of the component species of the vegetation.

W. BOTTING HEMSLEY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Lord Walsingham, F.R.S., the High Steward elect, has issued a letter of thanks to the Senate, in which he promises to maintain the highest traditions of "our beloved University."

W. M. Hicks, F.R.S., late Fellow of St. John's College, and Principal of Firth College, Sheffield, has been approved for the degree of Doctor in Science. Dr. Hicks is the author of many important memoirs in mathematical physics, and of an approved text-book of dynamics.

Prof. Newton has been appointed a Manager of the Balfour Studentship Fund for five years.

A. H. L. Newstead, Scholar of Christ's, and E. W. MacBride, Scholar of St. John's, and President of the Union Society, have been nominated for research work at the Naples Zoological Station.

The Syndicate appointed for the purpose have selected a site for the Sedgwick Memorial Museum on the old Botanic Garden area, with a frontage to Downing Street. The proposed Museum will lie between the new Chemical Laboratory and the old Anatomical School, and complete one quadrangle of the new Museums group.

The following distinguished persons are proposed recipients of honorary degrees on June 16:—Lord Walsingham, F.R.S., the Marquis of Dufferin and Ava, K.P., G.C.B., Prof. Rudolf von Gneist, of Berlin, Sir Alfred Lyall, K.C.B., Sir Archibald Geikie, F.R.S., Antonin Dvořák, Prof. Karl Weierstrass, of Berlin, A. H. Taine, member of the French Academy, Dr.

Elias Metschnikoff, Director of the Paris Pasteur Institute, Prof. W. H. Flower, C.B., F.R.S., and Mr. W. E. H. Lecky.

Delegates from the seventh International Congress of Hygiene and Demography will be received by the Vice-Chancellor in the Senate House on Saturday, August 15.

The Museums Association hold their annual meeting in July in the buildings lately erected for the departments of Anatomy and Physiology.

Prof. Foster is appointed by the University a Member of Council of the Marine Biological Association.

The reference to the Syndicate on the question of Greek in the Previous Examination has been enlarged to include Latin also, and will be decided on by the Senate early in the October term. An animated discussion on the question took place in the Arts School, in which the claims of modern (non-classical) education for consideration by the University were strongly put forward by men of the highest classical distinction.

Mr. J. N. Keynes, the Secretary for the Local Examinations, has been approved for the degree of Doctor in Science.

An election to an Isaac Newton Studentship will take place in October. The value is £200 a year for three years from April 15, 1891. Candidates are to send their names and testimonials to the Vice-Chancellor between October 1 and 10.

It is proposed to affiliate the University to the University of Adelaide, South Australia.

The General Board of Studies propose that Dr. Ruhemann, hitherto Assistant to Prof. Dewar, shall be appointed a University Lecturer in Organic Chemistry.

A room in the new Physiological Laboratory is to be set aside for Psychophysics, and a grant of £50 for instruments is recommended by the General Board.

The Annual Report of the University Observatory contains a good record of work done and in progress. Prof. Adams is to be congratulated on the satisfactory way in which, notwithstanding his long and severe illness, the Observatory has been conducted.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 14.—"On the Theory of Electrodynamics." By J. Larmor, Fellow of St. John's College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

The electrical ideas of Clerk Maxwell, which were cultivated partly in relation to mechanical models of electrodynamic action, led him to the general principle that electrical currents always flow round complete circuits.

When this principle of circuital currents is postulated, the theory of electrodynamics is reduced to the Ampère-Neumann theory of complete circuits, of which the truth has been fully established. It leads, as shown by Maxwell, to the propagation of electrical action in dielectric media by waves of transverse electric displacement, which have the intimate relations to waves of light that are now well known.

The problem of determining how far these remarkable conclusions will still hold good when a more general view of the nature of dielectric polarization is assumed was considered by von Helmholtz in a series of memoirs.

The most general conception of the polarization of a medium which has been formed is the Poisson theory of magnetization. The magnetized element, whether actually produced by the orientation of polar molecules, or otherwise, may be mathematically considered to be formed by the displacement of a quantity of ideal magnetic matter from its negative to its positive pole, thereby producing defect at the one end, and excess at the other end. The element is defined magnetically by its moment, which is the product of the displaced quantity and the distance through which it is displaced. The displacement per unit volume, measured by this product, is equal to the magnetic moment per unit volume, whether the magnetized molecules fill up the whole of that volume or are a system of discrete particles with unoccupied space between them.

In the electric analogue we replace ideal magnetic matter by ideal electric matter; the displacement thus measured constitutes the electric displacement, and its rate of change per unit time represents the displacement current in the dielectric. We have to consider whether a displacement current of this type suffices to make all electric currents circuital; and it will be sufficient and convenient to examine the case of a condenser which is charged through a wire connecting its two plates. In the first place, this notion of electric displacement leads to the same distribution of potential between the plates as the ordinary one, adopted by Maxwell; for in the theory of induced magnetism there occurs a vector quantity of circuital character, the magnetic induction of Maxwell, of which the components are $-\mu(dV/dx)$, $-\mu(dV/dy)$, $-\mu(dV/dz)$, and which, therefore, leads to the characteristic equation of the potential

$$\frac{d}{dx}\left(\mu\frac{dV}{dx}\right)+\frac{d}{dy}\left(\mu\frac{dV}{dy}\right)+\frac{d}{dz}\left(\mu\frac{dV}{dz}\right)=0,$$

corresponding to the one given above. If the displacement in the dielectric is $-\kappa(dV/dx)$, $-\kappa(dV/dy)$, $-\kappa(dV/dz)$, then

$$\mu = 1 + 4\pi\kappa.$$

The displacement in a unit cube may, of course, be considered as a displacement across the opposite faces of the cube.

Now, considering the case of a plane condenser, let F be the electric force in the dielectric between the plates; then the displacement is κF. Let σ be the surface density of the charge conducted to a plate; then the effective electrification along that plate will be of surface density $\sigma' = \sigma - \kappa F$; therefore, by Coulomb's principle,

$$\begin{aligned} F &= 4\pi\sigma' \\ &= 4\pi(\sigma - \kappa F); \end{aligned}$$

so that

$$\sigma = \frac{\mu}{4\pi}F = \kappa F + \frac{1}{4\pi}F.$$

Thus the current is not circuital, but there is an excess of the surface density conducted to the surface over the displacement current from the surface, which is equal to $F/4\pi$.

The specific inductive capacity, as determined by static experiments on capacity, is here measured by μ, the coefficient in the expression for σ.

In addition to this discontinuity at the face of a condenser plate, the induction in the mass of the dielectric will not be circuital unless the electric force is itself circuital, which it is not in the general form of the electrodynamic theory.

The most general type of electrodynamic relations which is consistent with the established theory of complete circuits, is discussed on the basis of von Helmholtz's work, but with avoidance of certain restricting conditions introduced by him, the chief conclusion being as follows:

In a complete circuit the one thing essential to the established theory is that the electric force integrated round the circuit should be equal to the time rate of change of the magnetic induction through it, and, therefore, have an ascertainable value, though its distribution round the circuit is a subject of hypothesis. The conclusion that waves of transverse displacement will be propagated in a dielectric with velocity $K^{-\frac{1}{2}}$ will hold good if we assume any form whatever for the electric force which does not violate this one relation, and also assume an electrostatic polarization of the medium, equal at each point to the electric force multiplied by a constant $K_1/4\pi$.

The increased generality which can be imparted to the theory merely leads to various modes of propagation of a condensational wave.

If K_2 denote the specific inductive capacity of the medium, measured in static units, this polarization constant K_1 is equal to $K_2 - 1$; and the velocity of the transverse waves is the ratio of the electric units of quantity in a medium of unit inductive capacity multiplied by the static value of $K_1^{-\frac{1}{2}}$. The correspondence of the refractive index for the simpler media with $K_2^{-\frac{1}{2}}$, as well as direct measures of the relative velocities of electric waves in other media, give for the value of this velocity the same ratio multiplied by $K_2^{-\frac{1}{2}}$. These values can be reconciled only by the limiting form of the theory of polarization which is equivalent to Maxwell's theory.

May 28.—"On the Anatomy and Physiology of *Protopterus annectens*." By W. N. Parker, Ph.D., F.Z.S., Professor of Biology in University College, Cardiff. Communicated by W. H. Flower, F.R.S.

The work which has resulted in the present paper was begun in Freiburg in the summer of 1888, when the author was fortunate enough, owing to the generosity of Prof. Wiedersheim, to obtain a number of fresh specimens for examination. As so many interesting points presented themselves at an early stage

in the research, a short preliminary notice, without illustrations, was published in the following autumn (*Berichte d. Naturforsch. Gesellschaft zu Freiburg i. Br.*, vol. iv. 1888; see also NATURE, vol. xxxix. p. 19) This notice merely forms the basis of the present paper, in which the whole subject has been worked out in greater detail. A number of new facts are recorded, some of the author's earlier conclusions modified, and the paper illustrated with 11 plates containing 71 figures.

With the exception of certain special details, the structure of the skeleton and of the nervous and muscular systems are not described, the paper consisting mainly of an account of other organs which have not received so much attention from previous observers, and of a comparison of *Protopterus* with the other genera of Dipnoi, so far as their structure is known, as well as with other Ichthyopsida.

A number of details with regard to the habits of *Protopterus* in captivity are given.

The paired extremities show no connection with the cheiropterygium, and, in spite of their considerable nerve-supply, are evidently greatly degenerated structures as regards their free portions. Sensory organs are not present on them, and they therefore cannot have a tactile function. Their distal ends, like the apex of the tail, are very variable, and can undoubtedly be reproduced when lost by accident. The tail is almost certainly not primarily diphycercal, and shows signs of a possible origin from a heterocercal form.

The epidermis on the whole most nearly resembles that of Perennibranchiate Amphibians, and gives rise to simple multicellular glands, as well as to very numerous closely-packed goblet-cells, which produce the gluey secretion as well as the main substance of the capsule which surrounds the animal during the torpid state.

The integumentary sense-organs are similar to those of fishes and larval Amphibians. The relations of the sensory organs of the trunk are similar to those seen in young stages of Fishes and in Amphibian larvæ, while in the case of the head they resemble those which are typical for adult Fishes. End-buds, similar in structure to the taste-buds of Fishes and Amphibians, are present on the tongue and oral epithelium.

As regards its general structure, the olfactory organ most nearly resembles that of Elasmobranchs, but the presence of posterior nostrils raises it to a higher level. The position of the anterior nostrils beneath the upper lip is probably to be accounted for as an adaptation in connection with the torpid state. Four straight and two oblique muscles are present. The sclerotic is fibrous in young animals, and islands of cartilage first appear at the points of insertion of eye-muscles, and then gradually extend so as to chondrify the whole. The eye resembles that of Amphibians; a *processus falciformis* and *campanula Halleri* are absent, and no ciliary muscles were observed, though possibly present; almost all the pigment of the eye is ectodermic.

No specialized glands are present in connection with the greatly folded epithelium of the oral cavity. The lips contain no muscles. The tongue, as well as the palate, is covered with blunt conical papillæ, on which the taste-buds are situated. A horny cap is developed over each tooth from the overlying epithelium, which apparently becomes cut through by the sharp edges and points of the teeth, and which probably corresponds to the *cuticula dentis*. The thyroid and thymus are described.

A ventral, as well as a fenestrated dorsal, mesentery is present supporting the intestine. The author compares the so-called urinary bladder ("cloacal cæcum") with the "processus digitiformis" of Elasmobranchs. A spleen and pancreas are present, embedded in the thin walls of the stomach, and extending on to the proximal part of the intestine; they are covered externally by sparse muscular fibres as well as by the peritoneum. The relations of the pancreas therefore most nearly resemble those met with in Ganoids and certain Teleosteans. The pancreas is deeply pigmented, and its ducts open into the bile-duct. The pigmented walls of the intestine and the spiral valve are very thick, owing to the abundance of lymphoid tissue contained within them. With the exception of the bursa entiana, the internal walls of which are raised up into a number of deeply pigmented oblique folds, the whole of the mucous membrane of the stomach and intestine is perfectly smooth, and there is no indication of any differentiated gastric or intestinal glands.

Cilia are present on the epithelium throughout the stomach and intestine. A layer of small-celled lymphoid tissue directly underlies the epithelium. In the spleen and lymphoid organs of the intestine two kinds of tissue are present. Large migratory cells are present in both kinds of tissue, many of which inclose yellowish granules. Gradations between these and rounded cells of a deeper yellow or brown colour can apparently be made out, and cells appearing to be intermediate forms between these and the ordinary black, branched pigment cells can also be seen. It seems probable that the yellow granules mentioned above are due to the disintegration of red corpuscles, which are ingested by leucocytes, and then undergo some change, whereby the latter gradually pass into the condition of black pigment cells, which migrate through the epithelium, and are so got rid of. The muscular layers are very thin.

The question as to the mode of digestion and absorption of the food in *Protopterus* is discussed.

The branchial apparatus shows signs of considerable reduction. The pulmonary apparatus, on the whole, more nearly resembles the air-bladder and its duct of certain Ganoids than the lungs and laryngo-tracheal chamber of Amphibians. The pulmonary branches of the vague cross one another at the base of the lungs.

The blood is remarkable for the large size of its elements, which is only exceeded in the case of *Proteus* and *Siren*, as well as for the large proportion of white corpuscles in comparison with the red ones. Two forms of the former are described. The chief points of interest with regard to the blood-vessels are: (1) the paired pulmonary artery, the left supplying the ventral, and the right the dorsal, aspect of the lungs; (2) the single post-caval and persistent left posterior cardinal vein; and (3) the single caudal vein, giving rise to a right and a left renal portal.

No external sexual differences could be observed, and amongst the specimens examined, females were the more abundant. The urino-genital organs are surrounded by masses of tissue resembling the large-celled lymphoid tissue of the gut, but differing from the latter in becoming largely converted into adipose tissue. The kidneys probably represent the mesonephros, and their duct the Wolffian duct; nephrostomes are absent.

In unripe males, delicate Müllerian ducts are present. The sperm is conducted to the exterior by a duct, which is probably formed in connection with the testis, quite independently of the excretory apparatus. The seminal tubules are directly connected with it, and it opens into the base of the Müllerian duct, the rest of which apparently aborts completely. Unlike most of the tissue elements, which are very large, and closely resemble those of the Amphibia, the spermatozoa are very minute, and are remarkable in possessing *two* vibratile flagella attached to the carrot-shaped "head." The generative organs of the female bear a striking resemblance to those of Amphibians. The oviduct corresponds to the Müllerian duct; the epithelium covering its internal folds shows signs of degeneration similar to those which have recently been described amongst Urodeles.

An account of the mode of life of *Protopterus* during the torpid period is given. The cocoon is provided with a "lid," perforated by a hollow funnel-shaped tube, which passes between the lips of the animal, and thus forms a passage for the respiratory current. The source of nutriment during the summer sleep lies in the adipose tissue in connection with the gonads and kidneys and alongside the notochord in the tail, as well as in the lateral muscles, some of which, especially in the caudal region, undergo a granular degeneration. Very probably the latter is the precursor of the fatty degeneration, and, in all probability, leucocytes are the active transporting agents of the degenerated material. This assumption would help to explain the large development of lymphoid tissue in the body of the animal.

The systematic position of the Dipnoi is briefly discussed in the light of the new facts brought forward in the present paper. Although the Dipnoi present many points of resemblance to Fishes on the one hand, and to the lower Amphibians on the other, their connection with any living forms of either class is probably a very distant one, and it is inadvisable to classify them amongst the Fishes. Owing to the absence of ontological evidence, and to the incompleteness of our knowledge of the palæontological history of the Dipnoi, it is impossible to construct a genealogical tree which will show, with any approach to accuracy, the probable connection between them and other Ichthyopsidan types. The most that can be said at present, with anything like certainty, is that the Dipnoi are the isolated survivors of an exceedingly ancient group, which was probably related to the ancestors of existing Fishes and Amphibians. Amongst the former, the connection seems to be closest to the

Elasmobranchs, more particularly to the Chimæroids on the one hand, and to such an ancient Selachian type as *Chlamydoselache* on the other; but, at the same time, the Ganoids probably arose from the common ancestral stock not very far off. Though retaining many primitive characters, the Dipnoi, and more especially *Protopterus* and *Lepidosiren*, are in some respects highly specialized, the specialization being largely due to a change of habit.

"Method of Indexing Finger Marks." By Francis Galton, F.R.S.

Sufficient proof was adduced by me in a memoir read November 27, 1890, before the Royal Society (Phil. Trans., B, 1891), of the extraordinary persistence of the papillary ridges on the inner surface of the hands throughout life. It was shown that the impression in ink upon paper of each finger tip, contained on the average from twenty-five to thirty distinct points of reference, every one of which, with the rarest exception, appeared to be absolutely persistent. Consequently that it was possible to affirm with practical certainty whether or no any two submitted impressions were made by the fingers of the same person.

In the present memoir I shall explain the way in which finger prints may be indexed and referred to after the fashion of a dictionary, and on the same general principle as that devised by A. Bertillon with respect to anthropometric measures, whose ingenious method is now in regular use on a very large scale in the criminal administration of France and elsewhere. I desire to show how vastly the practical efficiency of any such method as that of A. Bertillon admits of being increased by taking finger prints into account in the way to be described.

It must not, however, be supposed that the use of indexing finger marks is limited to the above purpose, the power of doing so being equally needed for racial and hereditary inquiries. I do not dwell upon these applications now, simply because I am engaged in making them, and the results are not yet ready to be published. I ought, however, to mention that a great increase of experience has fully confirmed my earlier views, that finger marks are singularly appropriate subjects of anthropometric study owing to many distinct reasons. The impressions are easily to be made by anyone who has the proper appliances at hand. They are as durable as any other printed matter, and they occupy very little space. The patterns are usually sharp and clear, and their *minutiæ* are independent of age and growth. They are necessarily trustworthy, and no reluctance is shown in permitting them to be taken, which can be founded either upon personal vanity or upon an unwillingness to communicate undesirable family peculiarities.

Without caring to dwell on many of my earlier failures to index the finger prints in a satisfactory way, my description shall be confined to that which has proved to be a success. It is based on a small variety of conspicuous differences of pattern in each of many digits, and not upon the numerous minute peculiarities of a single digit. My conclusions are principally based on a study of the impressions of all 10 digits of 289 different persons, but the tables given in the memoir refer only to the first 100 on my list. These are sufficiently numerous to serve as a fair sample of what we might always expect to find, while they are not too cumbrous to print and to discuss in full detail.

Though I have spoken and shall speak only of impressions, it is not really necessary in forming an index to make any impression at all. All the entries that appear in it may be derived directly from the fingers themselves.

I rely, for the purpose of indexing, on the three elementary divisions of primaries, whorls, and loops. They are severally expressed by the numerals 1 and 2, 3 and 4, 5 and 6. The reason of this double numeration is that most of the patterns have a definite axis. Those that are formed by ridges which proceed from only one side of the finger, lie in a sloping direction across its axis, the slope being directed according to the side from which the supply of ridges proceeds. All normal slopes, or those that are (roughly) parallel to a line drawn from the tip of the forefinger to the base of the little finger, as well as all the patterns that have no definite axis, are expressed by the odd numerals, 1, 3, or 5. All abnormal slopes are expressed by the even numerals 2, 4, or 6. It cannot be too strongly insisted that the words right and left are ambiguous, and must not be used here.

The forefingers are the most variable of all the digits in respect to their patterns, their slopes being almost as frequently abnormal as not; the third fingers rank next; the little finger ranks last, as its pattern is a loop in nine cases out of ten. I therefore found it convenient not to index the fingers in their natural order, but so that the sequence of the numerals which express the patterns on the digits should be divided into two groups of three numerals, and two groups of two numerals, as 355, 455, 55, 35. The first group 355 referring to the first, second, and third fingers of the left hand; the second group 455 to the first, second, and third fingers of the right hand; the third group 55 to the thumb and fourth finger of the left hand; the fourth group 35 to the thumb and fourth finger of the right hand. The index is arranged in the numerical sequence of these sets of numbers.

Before translating the patterns into numerals, I find it an excellent plan to draw symbolic pictures of the several patterns in the order in which they appear in the impression, or in the fingers themselves, as the case may be, confining myself to a limited number of symbols [a list of those which have thus far sufficed is given in the memoir; 5 of them are symmetrical symbols, and 9 are tailed and duplicated for the reasons given above, one of each pair being inclined to the right, and the other to the left. The total number of these hieroglyphs is consequently 23]. A little violence has of course to be used now and then, in fitting some unusual pattern to one of these symbols. But we are familiar with such processes in ordinary spelling, where the same letter does duty for different sounds, as *a* in the words *as*, *ask*, *ale*, and *all*. The merits of this process are many. It facilitates a leisurely revision of first determinations; it affords an adequate record of the character of each pattern; it prevents mistakes between normal and abnormal slopes; it prevents confusion when changing the sequence of the entries from the order of the impressions to that used in the index; and, lastly, it affords considerable help to a yet further subdivision of the patterns.

In making a large and complete index, the symbols would, of course, be cast as movable types, and be printed with the letterpress.

It appears from the 100 cases that are printed in the memoir that there were 83 different varieties of index numbers when all 10 digits are used. Consequently the average number of references required to pick out a single well-defined case from among these 100 would be equal to 100 divided by 83—that is, to about 1¼. I do not expect from my own reiterated experiences that there would be much trouble due to transitional cases, after a standard collection of doubtful forms had been collected and numbered, so as to insure that different persons should follow a common standard. I find much uniformity in my own judgment.

Owing to the large effect of correlation, an index based on all the 10 digits is not much superior in efficiency to one that is based on six—namely, upon the first three fingers of both hands. In the 100 different sets there are, as already said, 83 varieties of pattern in the one case, and there are 65 in the other, which roughly accords with the relative efficiency of 5 to 4. It is, therefore, a fair question whether it is worth while to impress all the 10 digits. The chief advantage of doing so is to add to the volume of evidence, and to supply data which mutilation, or bad scars, or obliteration due to some exceptional cause might render of value. The three fingers of both hands are more than twice as useful for an index as those of one hand only; again, the three fingers of one hand are nearly twice as useful as two only. I may mention that for my present inquiries into racial and hereditary patterns I am, for various reasons, dealing only with the first three fingers of the right hand, and slightly rolling the forefinger, so as to obtain a full impression of its pattern on the side of the thumb.

When searching through a large number of prints that bear the same index number, in order to find a duplicate of a particular specimen, it is a very expeditious method to fix on some one well-marked characteristic of a minute kind, such as an island, or inclosure, or a couple of adjacent bifurcations, that may present itself in any one of the fingers, and in making the search to use a lens or lenses of low power, fixed at the end of an arm, and to confine the attention solely to looking for that one characteristic. The cards on which the finger marks have been made, may then be passed successively under the lens with great rapidity.

[It is proposed to exhibit specimens illustrative of this and of the previous memoir, together with appliances for taking impressions from the fingers, at the approaching *soirée* of the Royal Society.]

Physical Society, May 22.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—Mr. C. J. Woodward exhibited Dr. Schobben's form of lantern stereoscope. This instrument consists of a double lantern, by which the two pictures of a stereoscopic slide are projected on a screen. The two pictures are coloured complementary tints by placing pieces of red and green glass in front of the lenses, and each observer views the overlapping images through spectacles, the eye-glasses of which are also coloured red and green. The stereoscopic effect is very striking. Mr. Boys stated that he had tried to obtain a similar result with the aid of polarized light, by viewing two polarized images through Nicol prisms. No effect was obtained, owing to elliptic polarization produced by the screen, but he thought that if a dead-gold screen had been used instead of an ordinary one, the effect might have been observed.—Prof. Perry, F.R.S., showed a new form of steam-engine indicator. A galvanometer mirror is fixed excentrically to a steel disk, forming one side of a chamber communicating with the cylinder. The pressure of the steam bulges out the disk, and causes the mirror to deflect a ray of light thrown on it in the ordinary way. A rotation of the mirror at right angles to the former is imparted by the movement of the piston-rod. The ray of light traces out the diagram on a screen suitably placed, and the complete figure is continuously visible, owing to the persistence of impressions. This indicator possesses advantages over other forms, in being free from errors due to friction or oscillations of the springs, and the alteration of their elasticity due to temperature changes. The errors of ordinary indicators are considerable at high speeds, owing to the ripples introduced into the indicator diagram. If the natural period of the springs is one-twentieth of the time of a revolution, the diagram is fairly free from ripples, but if it is as much as one-tenth, no amount of friction in the indicator will prevent ripples forming. In the new indicator, the natural period of the disk can be made very short. The steel disks are easily removable, and can be proportioned to suit different pressures and speeds. For experimental and teaching purposes it is advantageous to see at once the alterations in the diagram caused by changes of load, pressure, &c. Several diagrams were exhibited to the meeting. In reply to Prof. Carus Wilson, Prof. Perry stated that the deflection was proportional to the pressure in the cylinder within the limits any particular disk was intended for. Mr. Addenbrooke thought the instrument an important improvement on its predecessors, and considered it would prove of great service to electrical engineers. Mr. Swinburne said a peculiar merit of the indicator was that it could be permanently attached to an engine like an ordinary pressure-gauge. He suggested the use of a small telescope instead of the ray method. The President thought that the instrument could be modified so as to be useful for analyzing the shape of the curves representing alternating currents.—On Blakesley's method of measuring power in transformers, by Prof. Perry, F.R.S. This paper refers to the supposed error in Mr. Blakesley's formula due to the fact that transformers show magnetic leakage. The proofs of the formula hitherto given have been obtained by treating the equations in the manner first adopted by Dr. Hopkinson. On this system the reactions of the primary and secondary currents are represented by the equations—

$$V = R_1C_1 + P\frac{dN}{dt}, \quad o = R_2C_2 + S\frac{dN}{dt},$$

where P and N are respectively the turns on the primary and secondary coils, and N is the magnetic flux between the coils. Here it is assumed that there is no magnetic leakage, and the author thinks that on this account the method is inferior to the original method of Maxwell, in which the induced electromotive forces are expressed in terms of coefficients of self and mutual induction. On the assumption that there are no eddy currents, Maxwell's equations are—

$$V = R_1C_1 + L_1\dot{C}_1 + M\dot{C}_2; \quad o = R_2C_2 + MC_1 + L_2\dot{C}_2,$$

in which although L_1, M, and L_2 may not be constant, it may be assumed that they are respectively proportional to P^2, PS, and S^2, if there is no magnetic leakage; and if the amount of magnetic leakage bears a constant proportion to the whole flux, the three quantities may still be assumed proportional to each other, although M^2 is less than L_1L_2. From these equations we obtain

$$VC = R_1C_1^2 - R_2\frac{M}{L_2}C_1C_2 + \frac{L_1L_2 - M^2}{L_2}C_1\dot{C}_1.$$

Hopkinson puts down the last term as zero, but owing to the very rapid rate at which C_1 changes, the last term is very important, even though M may be but a small percentage less than $\sqrt{L_1L_2}$. On integrating this equation, the first two terms on the right-hand side yield Blakesley's formula, and the last term vanishes in the integral, because, however great the magnetic leakage may be,

$$\int C_1\dot{C}_1dt = o,$$

when taken over a period because the functions are periodic. Mr. Blakesley's formula thus appears to hold, whatever the magnetic leakage. The paper contains several tables of calculations showing the effect of magnetic leakage on the value of the terms in the equation. Mr. Blakesley said he doubted the correctness of the assumption that the value of M was the same in the two equations, and thought that the result arrived at must be incorrect. Dr. Sumpner did not doubt that if the coefficients could be considered constant, the formula was true whatever the leakage, but he did not consider that the action of transformers justified such an assumption. If the formula were true, it would also hold if there were eddy currents, as these would merely produce the effect of additional secondary coils. He had analyzed Blakesley's method by using a modification of the Hopkinson equations, and had shown that the power as estimated by Blakesley's formula had to be lessened by the fraction represented by the expression

$$X = \frac{\int x\dot{A}_p\int A_sdtdt}{e + \int A_pA_sdt},$$

where A_p and A_s are the instantaneous values of the primary and secondary currents, and x is such that $N_p = N_s(1 + x)$ where N_p and N_s are the fluxes of magnetism through the primary and secondary coils at the same instant; e is a negligibly small quantity compared with the rest of the denominator. In obtaining this factor no assumptions whatever had been made, and it was easy to see that if A_p and A_s could be assumed sine functions, and x a constant, the value of the factor X became x simply. In only one case did X reduce to zero, and that was when x was a sine function of the same period as A_p and A_s. He believed that in actual transformers x was approximately constant. Mr. Swinburne pointed out that the split dynamometer was merely a watt-meter, and stated that he had transformers which, owing to magnetic leakage, would indicate an efficiency of over 100 per cent. if tested by Blakesley's method. If this method gives an efficiency of 96 per cent., and leakage causes a drop of 2 per cent. in E.M.F., the real efficiency is only about 94 per cent. He thought that the assumption that the currents followed a sine law was equivalent to supposing that there was no loss in hysteresis. The President said that no one would be more glad than himself to find that Mr. Blakesley's method was accurate, but he could not agree with Prof. Perry that Dr. Hopkinson was wrong in abandoning the academical method of Maxwell. Prof. Perry replied to the various points raised in the discussion.—A paper on current and potential difference analogies in the methods of measuring power, by Prof. W. E. Ayrton and Dr. Sumpner, was postponed.

Royal Microscopical Society, May 20.—Dr. R. Braithwaite, President, in the chair.—The President said he regretted to have to announce the deaths of two of their Honorary Fellows, Dr. Carl von Naegeli, of Munich, and Prof. J. Leidy, of Philadelphia.—Mr. C. L. Curties exhibited a new form of Mayall's mechanical stage, recently manufactured by Zeiss, which gave upwards of an inch motion each way, and merely required to be clamped on the pillar of the microscope when wanted for use.—Mr. Watson exhibited and described a microscope which he had recently made specially to meet the wants of Dr. Van Heurck, of Antwerp. Mr. Mayall, after criticizing the design, for which, he understood, Dr. Van Heurck was responsible, concluded by expressing his regret that Dr. Van Heurck's specification should have resulted in the production of the microscope exhibited. Mr. E. M. Nelson and the Rev. Dr. Dallinger also criticized the instrument adversely.—Mr Grenfell exhibited the photograph of a small organism, the nature of which he had been as yet unable to determine; some zoologists and botanists to whom he had shown it were unable to say whether it was vegetable or animal in its nature. He also wished to mention that in the Botanical Gardens, Regent's Park, there were considerable numbers of a free-swimming infusorian known as *Tintullus*. It was remarkable for its chitinous loricæ.

Claparède mentioned its having been found at Berlin; but hitherto it had only seemed to have been found in sea-water.—Prof. Bell said they had received a communication from Mr. J. B. Rosseter describing the development of *Tænia lanceolata* from the duck, the cysticercoid form of which had not been previously known. He (Mr. Rosseter) had fed the ducks with some of the *Cypris* known to be infested with the parasite, and after some weeks opened the ducks and found the tapeworm mentioned. It was interesting to get the life-history of another tapeworm worked out.—Mr. E. M. Nelson read a note on the subject of lateral development in photography, and a paper on the use of monochromatic light in microscopy, and exhibited the model of a new and simple apparatus for obtaining the same by means of a glass prism. Mr. Nelson also described a new projection microscope fitted with a special condenser made of three flint lenses so as to embrace the whole cone of 82°. The novelty about it was the system of collecting the light, by which a beam of 4¼ inches was brought down to 1¼ inches, and by passing through two lenses placed in the water-trough, a beam of parallel rays of great intensity was obtained for use in projecting the image upon the screen. Afterwards Mr. Nelson gave an exhibition on the screen.

Geological Society, May 27.—Dr. A. Geikie, F.R.S., President, in the chair.—The following communications were read:—On the lower jaws of *Procoptodon*, by R. Lydekker. After reviewing Sir R. Owen's writings upon the large extinct Kangaroos for which he established the genus *Procoptodon* in 1874, the author describes two mandibular rami from the clay beds of Miall Creek in the neighbourhood of Bingera, N.S.W., which belong to this genus, and from their characters and a comparison of them with the lower jaws in the British Museum, he maintains that this part of the skull indicates two very distinct species of the genus, for which he retains the names *P. rapha*, Ow., and *P. goliah*, Ow., though it is possible that the types of those two species are really specifically identical, in which case the name *P. pusio*, Ow., might have to be adopted for one of the species described.—On some recently exposed sections in the Glacial deposits at Hendon, by Henry Hicks, F.R.S. In this paper the author brings forward evidence obtained from sections exposed in gravel-pits and deep cuttings made for the purpose of laying down the main sewers, to show that Glacial deposits had been spread out to a much wider extent over the Hendon plateau than had hitherto been supposed, and that they had reached down the slopes to below the Ordnance-datum line of 200 feet. He further mentions that there is evidence to show that these deposits have extended in a south and south-west direction across the Brent and Silk Valleys, and now occur on most of the heights in the parishes of Kingsbury and Willesden. As the sands, gravels, and Boulder-clay which cover the Hendon plateau and the neighbouring heights are found to rest on an undulating floor of London Clay, and to follow the contours of the hills and valleys, the author considers that it is clear that the main physical features of this portion of North-west Middlesex were moulded at a very early stage in the Glacial period, and before the so-called Middle sands and gravels and overlying Upper Boulder-clay with Northern erratics were deposited. He believes that at this time there could have been no barrier of any importance to prevent these deposits from extending into the Thames Valley, and that the evidence clearly points to the conclusion that the implement-bearing deposits on the higher horizons in the Thames Valley should be classed as of contemporaneous age with the undoubted Glacial deposits at Hendon, Finchley, and on the slopes of the Brent Valley, which they so closely resemble. The author is therefore satisfied that man lived in the neighbourhood of the Thames Valley in the early part of the Glacial period; probably, he thinks, in pre-Glacial times. This paper led to a discussion, in which Mr. H. B. Woodward, Mr. J. A. Brown, Dr. Hinde, Mr. Monckton, and the author took part.

Entomological Society, June 3.—Mr. Frederick Du Cane-Godman, F.R.S., President, in the chair.—Mr. E. B. Poulton, F.R.S., exhibited living larvæ of *Endromis versicolora*, and commented on their habits.—Mr. W. F. H. Blandford called attention to the fact that the larvæ of *Liparis monacha* remained in small groups on the bark of the tree for about a week after emerging from the eggs, and that this fact was taken advantage of by the German foresters to destroy them. Also that he had himself verified the statement that uric acid can be detected in the Malpighian tubes of insects. Mr. McLachlan, F.R.S., agreed that the demonstration that the Malpighian tubes were of the nature of renal organs was now satisfactory.—Mr. C. J. Gahan exhibited two species of Coleoptera that he considered to possess a mimetic resemblance.—Mr. Tutt exhibited a hybrid between *Amphidasis prodromaria* and *A. betularia*, obtained by Dr. Chapman. Mr. Stainton, F.R.S., commented on the fact that the two insects appeared at different times; and Mr. Tutt stated that the *A. betularia* had been subjected to forcing, so as to cause it to emerge at the same time as *A. prodromaria*.—Mr. Tutt also exhibited forms of *Caradrina*, some of which he said were considered distinct on the Continent, though they were not recognized as such in this country, viz. *Caradrina taraxaci* (*blanda*), *C. superstes*, Tr., from Sligo, and *C. superstes*, H. S., considered as synonymous with *superstes*, Tr., but apparently more closely allied to *C. ambigua*.—Mr. Bristowe exhibited varieties of *Arctia menthastri*, some of which had been fed on mulberry and others on walnut; no difference was observed in the variation.—Mr. G. Elisha exhibited larvæ in their cases of *Coleophora vibicigerella* and *C. maritimella*.—Mr. A. G. Butler communicated a paper entitled "Additional Notes on the Synonymy of the Genera of Noctuid Moths."

Zoological Society, June 2.—Prof. W. H. Flower, C.B., F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of May 1891, calling special attention to a female Water-buck Antelope (*Cobus ellipsiprymnus*) from British East Africa, presented by Mr. George S. Mackenzie, and to three Blanford's Rats (*Mus blanfordi*) from Kadapa, Madras, received in exchange, new to the collection.—Mr. Sclater made some remarks on the animals which he had noticed during a recent visit to the Zoological Gardens of Paris, Ghent, Antwerp, Rotterdam, Amsterdam, and the Hague.—Prof. Newton, F.R.S., exhibited (on behalf of Prof. Stirling, of the University of Adelaide), a drawing, being the first received in Europe, representing the remarkable new Australian Mammal lately described by Prof. Stirling as *Notoryctes typhlops*, which was stated to be the Mole-type of the order Marsupialia.—The Secretary exhibited (on behalf of Mr. F. E. Blaauw) specimens of the Long-tailed Tit, shot in Holland, and sent to this country for the purpose of ascertaining whether they belonged to the British form (*Acredula rosea*) or the white-headed Continental form (*A. caudata*).—Mr. F. Finn exhibited a hybrid Duck bred in the Society's Gardens, believed to be bred between a male Chilian Pintail (*Dafila spinicauda*) and a female Summer-Duck (*Æx sponsa*).—A communication was read from Dr. O. F. von Moellendorff containing a revised list of the Land and Freshwater Shells of Perak, with descriptions of some new species.—A communication was read from Dr. G. E. Dobson, F.R.S., containing a sketch of the derivation and distribution of the Mammals of the order Insectivora found in the New World.—Mr. G. A. Boulenger read a report on Reptiles, Batrachians, and Fishes of which specimens had been collected for the West Indian Exploration Committee in some of the Lesser Antilles, and deposited in the British Museum.—A communication was read from Mr. Hamilton H. Druce containing an account of the Butterflies of the family Lycænidæ obtained by Mr. C. M. Woodford in the Solomon Islands.

CAMBRIDGE.

Philosophical Society, May 18.—Prof. Liveing, Vice-President, in the chair.—The following communications were made:—On parasitic Mollusca, by Mr. A. H. Cooke.—Mr. W. Bateson exhibited and explained models of double supernumerary appendages in insects; and also a mechanical method of demonstrating the system upon which the symmetry of such appendages is usually arranged.—On the nature of the excretory processes in marine Polyzoa, by Mr. S. F. Harmer. This communication was the result of an occupation of a University table at the Zoological Station at Naples during the Easter Vacation of 1891. Observations were made on the manner in which various artificial pigments were excreted in *Bugula* and in *Flustra*, on the lines adopted by Kowalevsky (*Biolog. Centralblatt*, ix., 1889–1890, pp. 33, &c.) for other invertebrates. The general result of the experiments was to show that excretion is not performed by organs comparable with nephridia, but that this process is carried on by free mesoderm cells, and to some extent by the connective tissue and by the walls of the alimentary canal. Evidence was obtained to show that the periodic loss of the alimentary canals leading to the formation of the "brown bodies" may be regarded as, to some extent, an excretory process.

PARIS.

Academy of Sciences, June 1.—M. Duchartre in the chair.—Calorimetric researches on humic acid derived from sugar, by MM. Berthelot and André. The experiments show that humic acid is a polybasic acid which may be caused to unite with three equivalents of potash to form insoluble salts: one salt described is monobasic, stable, and formed with the evolution of 18 calories, an amount comparable with that evolved when alkaline salts are formed by the action of strong acids. Many other properties of this acid are given.—Analysis of the light diffused by the sky, by M. A. Crova. The observations recorded extend from December 1889 to the same month in 1890. From the results it appears that the blue colour of the sky is most intense in the months of December, January, March, and September; and shows minima in July, August, and November. Roughly, the blue colour is deepest in the winter, and palest in summer; spring and autumn give sensibly the same results. A comparison of the intensities at different hours of the day indicates that a maximum blue coloration occurs in the morning and a minimum at the hottest hour in the day.—On Abelian equations, by M. A. Pellet.—On a new method of determining the vertical motion of aërostats, by M. André Duboin. The methods usually employed by balloonists to determine their state of vertical motion are by means of a barometer, or by throwing out light bits of paper and observing whether they ascend or descend relatively to the balloon. The author has devised an apparatus having the same object, on the principal of Kretz's differential manometer, and claims for it a sensibility 150 times greater than the ordinary mercurial barometer.—New models of copper oxide batteries, by M. F. de Lalande. A 35 per cent. solution of potash is the liquid employed. In it dips a conglomerate of copper oxide and sand covered with a thin porous layer of metallic copper, and one or two zinc plates. A cell thus constituted is shown to be practically constant for three or four days, and is said to work for years without getting out of order.—Determination of molecular weights at the critical point, by M. Philippe A. Guye. Using Van der Waals's formula, the author deduces $d = 1146\frac{\delta\theta}{\pi(1670 + \theta)}$, where d is the critical density with respect to air, δ the critical density with respect to water—that is, the weight of the substance in grams occupying a volume of one cubic centimetre at the critical state—θ the absolute temperature, and π the pressure in atmospheres. It is then shown that the values of d obtained by means of this empirical formula are equal to the molecular weights of the substances investigated divided by 28·87.—Research on the separation of metals from platinum, and in particular of palladium and rhodium in the presence of common metals, by MM. A. Joly and E. Leidié. The platinum or palladium are converted into soluble nitrites by the addition of potassium nitrite, and are thus separated from other metals.—On the specific heats of some solutions, by M. W. Timofeiew. Alcoholic solutions of bichloride of mercury and cadmium iodide were used. It is shown that the difference between the molecular specific heat of the solution and solvent is sensibly equal in the case of both salts, the mean value being 52. Taking this value to represent the molecular specific heat of the salt in solution and the specific heats of the alcohols employed to be expressed by the formulæ,

$C^{methyl} = 0{\cdot}56755 + 0{\cdot}001633t$; $C^{ethyl} = 0{\cdot}53574 + 0{\cdot}002132t$;

it is shown that the observed and calculated specific heats of the solutions are very nearly the same in each case.—On the oxidation products of uric acid, by M. C. Matignon. The heats of formation and combustion of the principal derivatives of uric acid are considered.—On the employment of ammonium selenite for the identification of alkaloids, by M. A. J. Ferreira da Silva. The use of ammonium sulphoselenite for the detection of morphine and codeine was suggested by M. Lafon in 1885. The author shows how the method can be extended to other alkaloids.—On the development of the liver of Nudibranchiates, by M. H. Fischer. The research shows that the liver of Nudibranchiates is formed to a great extent by the left hepatic lobe of the embryo, and that the hepatic organs in two very different groups of Mollusca, the Lamellibranchiates and Nudibranchiates, are homologous productions.—The *Isaria*, a parasite of the larva of the cockchafer, by M. Alfred Giard.—The genera of the group of Clusia, and in particular the genus *Tovomita*, by M. J. Vesque.—On some supporting elements of the leaves of Dicotyledons, by M. E. Pée-Laby.—Diffusion of three distinct forms of titanium oxide in the Cretaceous strata of Northern France, by M. L. Cayeux. A microscopic examination of the residue after treating chalk with an acid leads the author to believe he has recognized the three crystalline forms of titanium oxide—rutile, anatase, and brookite.—The lichens on mulberry-trees, and their influence on silk culture, by M. G. Hallauer.—On the employment of carbon bisulphide against aërial parasites, by M. H. Quantin.

AMSTERDAM.

Royal Academy of Sciences, May 30.—Prof. Van de Sande Bakhuyzen in the chair.—Dr. Bakhuis Roozeboom treated of the solubility of mixed crystals of isomorphous substances. Admitting the absolute homogeneity of such crystals, according to the recent researches of Retgers, it is possible to deduce, by thermodynamical reasoning, that, when p and T are taken as constants, equilibrium is obtained when to a proportion a of the components in the mixed crystals, correspond two definite values C_1 and C_2 for the concentrations of the components in the aqueous solution. From the analogy between the said equilibrium and that between a liquid and a gaseous phase, composed of two substances, are further deduced some general conclusions as to the behaviour of solutions of two isomorphous salts when they are evaporated. This is done both for the case in which the mixed crystals form a continuate series, and that in which they present a hiatus. The latter was found in studying the solubility of $KClO_3$ and $TlClO_3$. Solid mixtures were obtained at 10° and 1 atm. from 0-36·3 and from 97·9-100 per cent. $KClO_3$. In the evaporation of any one solution, it tends to a composition, which is necessary to deposit the two kinds of crystals between which the hiatus exists.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Bacteria and their Products: Dr. Sims Woodhead (Scott).—Einleitung in die Theoretische Physik; Zweite umg. und verm. auflage: V. von Lang (Braunschweig, Viewig).—A Manual of Forestry, vol. ii.: Dr. W. Schlich (Bradbury).—The British Noctuæ and their Varieties, vol. i.: J. W. Tutt (Sonnenschein).—Practical Work in Organic Chemistry: P. W. Streatfeild (Spon).—Katalog der Bibliothek der Deutschen Seewarte zu Hamburg (Hamburg).—Catalogue of the Fossil Birds in the British Museum (Natural History): R. Lydekker (London).—The Solar Parallax and its Related Constants: W. Harkness (Washington).—Favourite Foreign Birds: W. T. Greene (Gill).—Anthropogeographie: Dr. F. Ratzel (Stuttgart, Engelhorn).—Notes on Building Construction, Part 2, new edition (Longmans).—Poachers and Poaching: J. Watson (Hall).—Modern Cremation, 2nd edition: Sir Henry Thompson (Paul).—Nature and Treatment of Diphtheria, 3rd edition: R. W. Parker (Lewis).—Riddles of the Sphinx: A Troglodyte (Sonnenschein).—Housing of the Poor: F. H. Millington (Cassell).—British Cage-Birds, Part 14: R. L. Wallace (Gill).—A Manual of Orchidaceous Plants, Part 7 (Veitch).—Tasmanian Official Record, 1891 (Hobart).—The Birds of Manitoba: E. E. Thompson (Washington).—Scientific Results of the Second Yarkand Mission; Coleoptera (Calcutta).—Smithsonian Report, 1889 (Washington).—Internationales Archiv für Ethnographie, Band 4, Heft 3 (Paul).—The Asclepiad, No. 30, vol. viii.: B. W. Richardson (Longmans).—Photographic Reporter, June (Hazell).

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